DECEMBER, 1937

Engineering and Mining Journal

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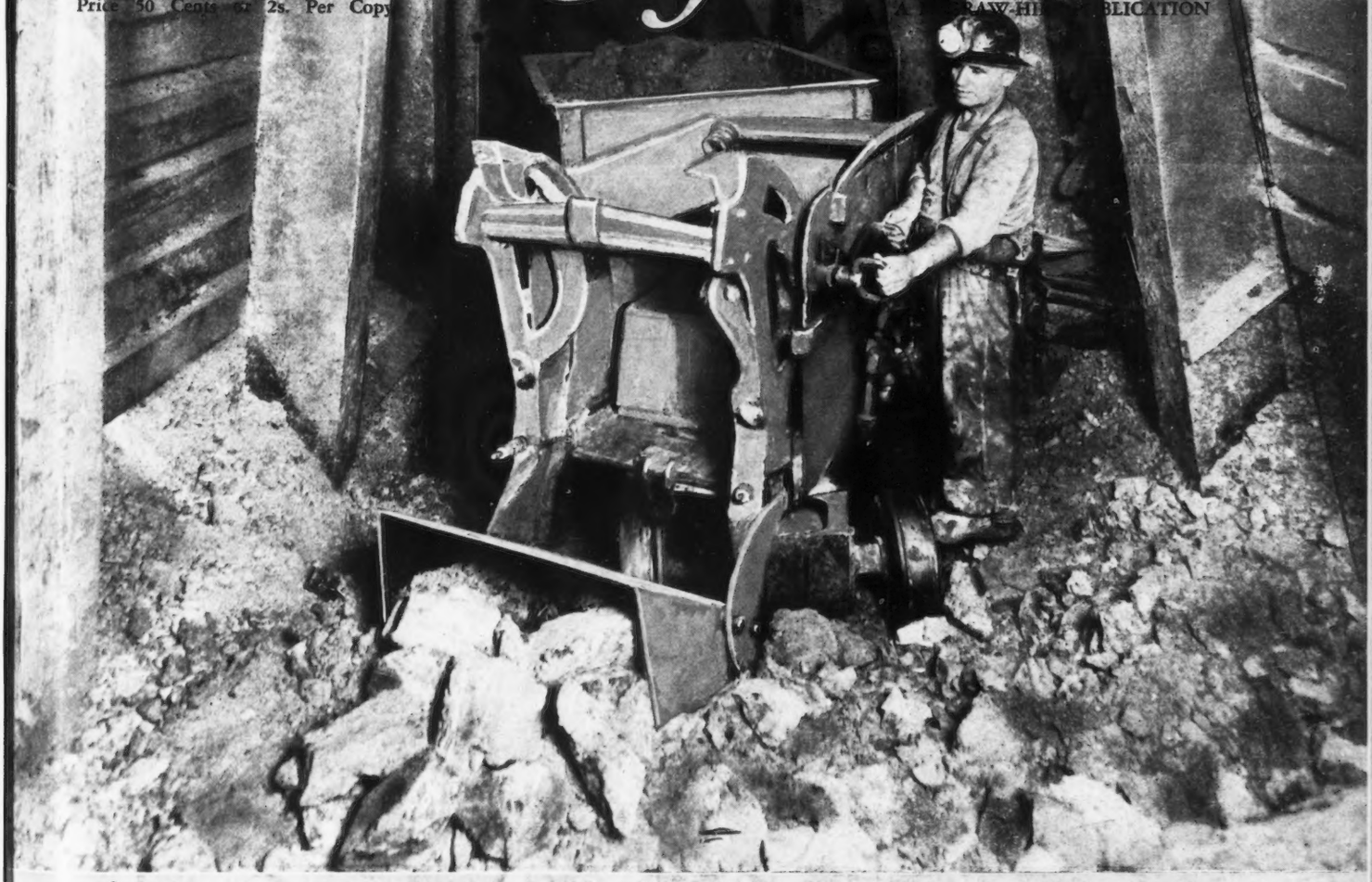

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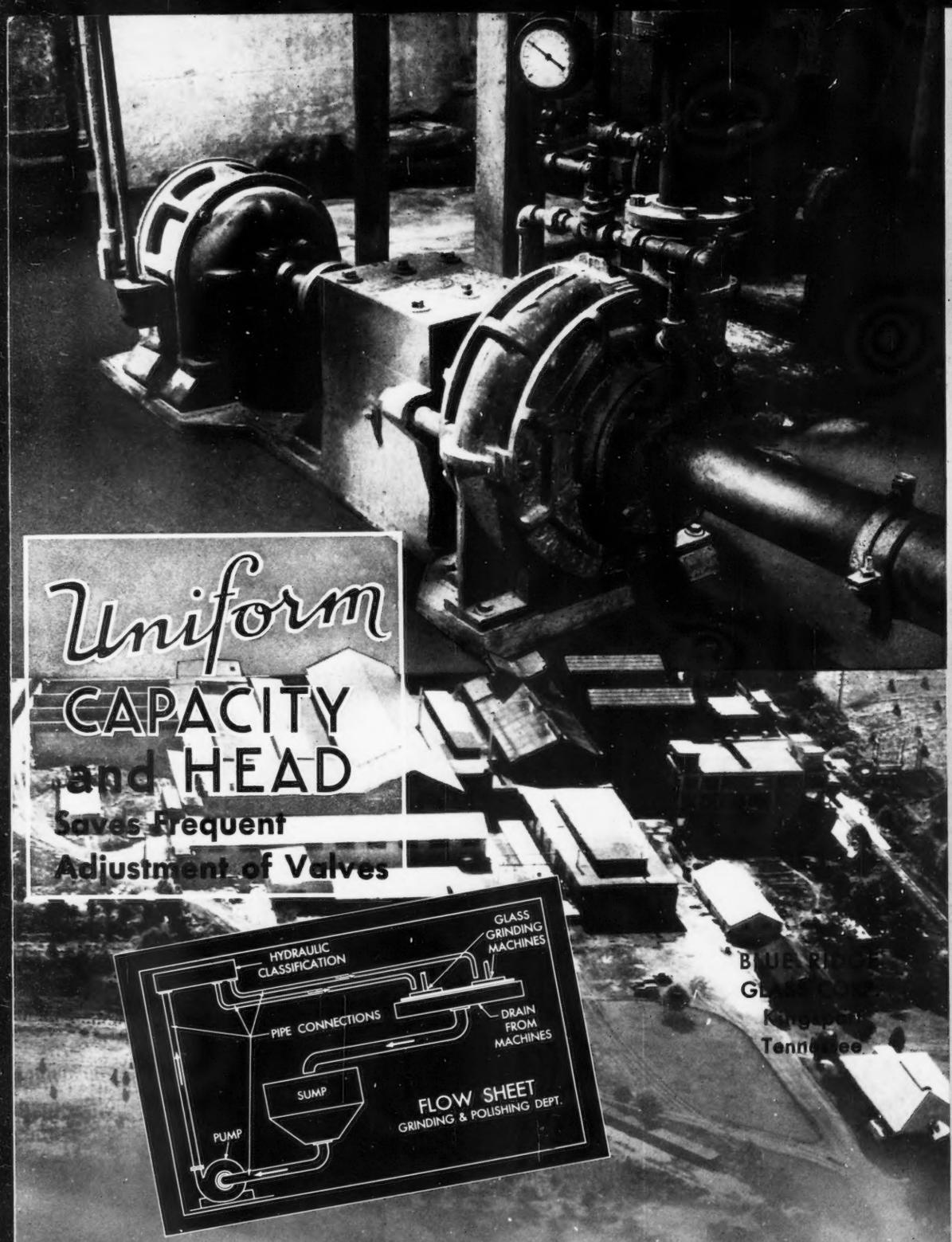

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Open-Pit transport of ore by truck and conveyor in the Lake Superior Iron Country is dealt with in an article on pages 50 and 51 in this issue. Another mine on the Western Mesabi—the LaRue, operated by Butler Brothers—is using conveyors not only in its open pit, as described in *E.&M.J.*, March, 1936, but below the surface for moving the entire output of the adjoining underground workings. The latter installation will be described in detail by Grover J. Holt in the January issue.

▼

"Deep Lead" mining as practiced in Australia has been applied successfully in a well-known property in the Cariboo district, British Columbia, under the direction of D. Campbell Mackenzie. Believing that the method may be important in developing other known deep-lead placer systems in North America, Mr. Mackenzie, upon request, has prepared an article discussing the application of the Australian method with particular reference to those cases where deep gravels are overlain with quicksand heavily charged with water. This will be published soon.

▼

Commemoration: The largest nugget of gold ever discovered was found in Australia. A marble shaft marks the spot where John Deason and Richard Oates uncovered it. On the base of the shaft appears the following: "Welcome stranger nugget. On this spot the largest nugget of gold found in the world was discovered on the 5th of February, 1869. Weight, 2,316 ozs."

▼

Industry is now using 50 per cent, by weight, of all the diamonds sold each year. African diamonds are marketed, on a quota basis, through a selling organization known as the Diamond Trading Company. Sales in 1934 were £3,719,000. For 1937 the total will reach, according to recent estimates, £10,000,000. The remaining half of the stones sold probably go to decorate the person, to delight the eye, to form a convenient concentration of wealth and make business for the money lenders.

▼

Water Transport figures largely in the affairs of the mine operators of the Lake Superior iron ranges. About 62,000,000 tons of ore has been so shipped in 1937. Large fleets, of various ownership, move the tonnage down the Lakes to the Lower Ports in a shipping season that runs approximately from mid-April to mid-November, depending on the weather. Launched on Nov. 10 at Lorain, Ohio, one of the two newest of the ore carriers, the "William A. Irvin," named for the president of the United States Steel Corporation, is 610 ft. long, of almost 19,000 tons' displacement. Ten days later, at River Rouge, Mich., the "Ralph H. Watson," named for the same corporation's vice-president in charge of mining operations, took the water.

▼

Republic Steel Corporation, second largest operator in the Birmingham district, Alabama, obtains the hematite ore used in its local furnaces from its Raimund mine on Red Mountain. The Raimund operations will be described in an early issue by N. E. Thompson, mine superintendent.

H. C. PARMELEE
Editorial Director

Engineering and Mining Journal

A. W. FISHER
Manager

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Vice-President

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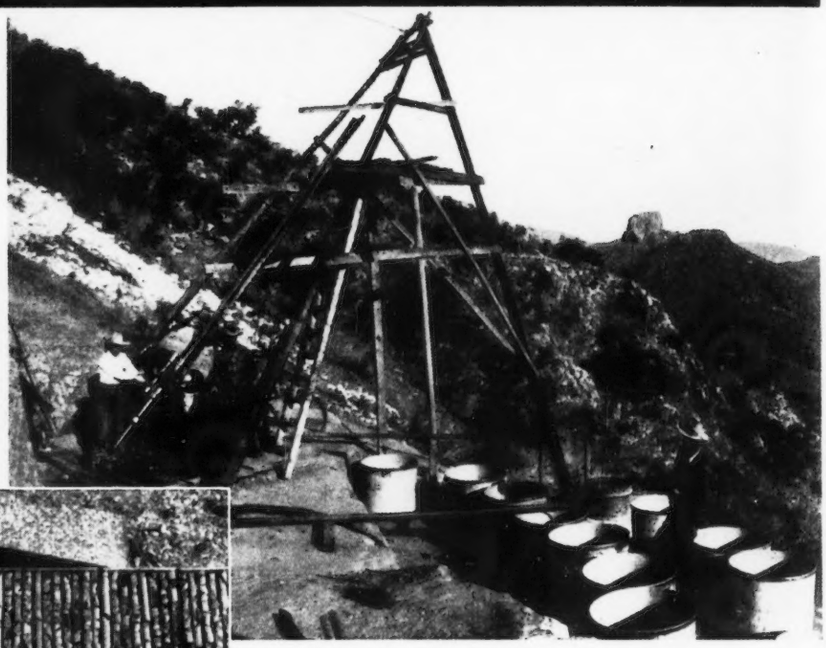
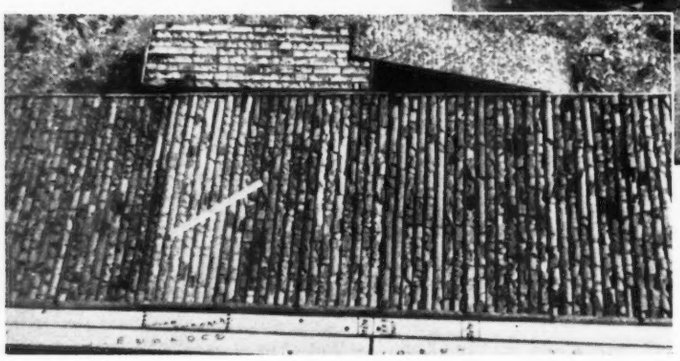
THE illustration shows Longyear Contract Core Drillers exploring a property in Sonora, Mexico. The return water was collected in eleven tanks in rotation. This allowed time for sludge to settle and to be recovered as part of the sample.





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Volume 138 Number 12

DECEMBER 1937

Return to Reason?

NOVEMBER 1937 may go down in the economic and political history of the United States as the turning point, not only in a three-month nose dive in business activity, but also in the attitude of the Administration toward business. Without being *too* demonstrative in his apprehension over the severe recession, the President nevertheless gave evidence of concern and a willingness to recognize the need of Federal action to turn the tide. But not until after Congress, convening for the special session, showed clearly that it was closer than the Executive to the situation and proposed to do something about it.

Reform and recovery have been the twin goals of the New Deal, but with the accent always on reform. So that even so slight a shift in emphasis as was evident in late November lent encouragement to those who have long hoped for a relaxation of pressure against business and industry. Publicly the President expressed himself as favorable to tax revision. He interviewed personally the heads of great public utilities that have been the objects of his disfavor, and learned first hand why they have deferred large expenditures for expansion. Following this outwardly mollifying gesture he emphasized more strongly than heretofore the necessity of balancing the budget, and let it be known that he might veto measures carrying excessive expenditures. Finally, he announced a drive for revival of house construction, and expressed his preference for reduced appropriations for road building.

None of this, however, implies that the President has abandoned his reform measures. Rather it reflects his recognition of the realism of Congress, which, convened to consider reform measures, promptly asserted its independence and plunged into a program of business recovery. For the first time in five years the Executive was on the defensive in respect to recovery, with the prospect of being held in that position throughout the regular session of Congress. Reform measures will still be pressed and they will keep business apprehensive. But they will have to be fought through against a stubborn opposition that will insist on modifications, and yield only in exchange for measures to rectify some of the mistakes of the past.

So tax legislation will come after the farm, wage-hour, and other bills have been considered. The total tax burden will not be lightened, but such uneconomic restrictions as the undistributed profits tax will be repealed or greatly modified. Whether the budget will be balanced or not will depend on the temper of Congress as well as on the determination of the President. And it still remains to be seen whether an accord will be reached between the utilities and the White House. But out of all these issues, forced into the open by Congress, comes the feeling that, willy-nilly, the Administration must give attention to recovery as well as reform. The severity of the current recession—certainly not "planned" by the New Deal, but undoubtedly resulting in some measure from its policies—makes an insistent demand for remedial attention.

Christmas Tree Economics

SEVERAL YEARS AGO Dean Vannevar Bush, Massachusetts Institute of Technology, made the following observation in the course of an address on engineering research: "There has been too much in this country of what may be called Christmas tree engineering. A product has a fault, so a gadget is added to correct it. But now the gadget develops a difficulty, so a second gadget is put on to remedy it. The continuation of this process produces something resembling a Christmas tree in the multiplicity of its complicated elements. This sort of thing is usually the result of exaggerated attention to the immediate at the expense of the basic."

Substitute "economics" for "engineering" and the observation of Dean Bush loses none of its fitness. With the free play of economic forces denied by dictators and greatly restricted by democratic governments, the economic machine is decorated with controls and limitations, to say nothing of proposed devices that have not yet been adopted. Price fixing, production control, wage and hour regulation, and other gadgets introduce complications that give unpredictable results.

Take tin control, for example. Tin is one

of the most regulated commodities in the world, under the direction of the International Tin Committee. Yet the gyrations in price this year suggest an airplane in the hands of a stunt flier. Straits tin in the New York market opened the year at 51.65¢ per pound, a fancy price if one may believe the consumer. Then came the London boom in high gear, and the price climbed to its peak of 66.75¢ in March. Toward the end of November the metal sold down to 41¢. And this in spite of production quotas and support of the control plan by the various governments involved. The tin control gadget, ideal as it was, failed to function because no one foresaw the decline in industrial activity in the United States, which consumes 45 per cent of the world's output of tin.

All of which suggests that in a complex world of interdependent nations, or even in a single nation of diverse but interdependent interests, the delicate economic machine can easily be thrown out of gear by ill-considered gadgets. Also that Christmas tree economics is quite as futile as Christmas tree engineering. Both are likely to grow out of "exaggerated attention to the immediate at the expense of the basic."

As Industry Progresses

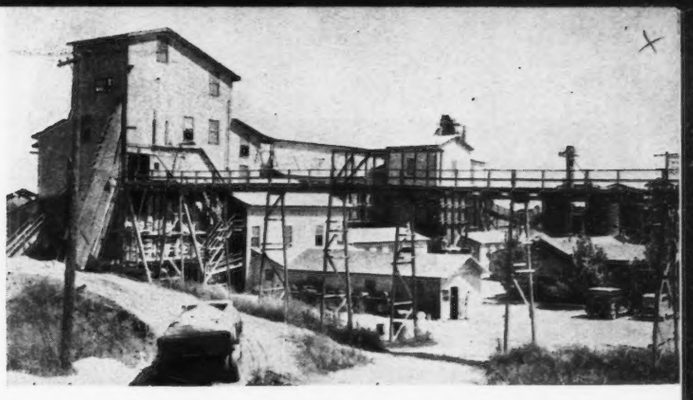
AS WE ENTER the period of retrospection that normally marks the closing of each year, the thought recurs that, for measuring the progress of technical developments, twelve months is much too short an interval. From the birth of an idea to its embodiment in machine or process and the latter's widespread commercial utilization, time usually expends itself so prodigally that a survey of a mere year's events often reveals what seems to be a negligible advance. One needs a slow-motion visualizer, as it were, at times to perceive what is being done. Despite this apparent dragging of development, the wider view, embracing several years within its scope, has invariably shown encouraging gain. Similarly as one looks ahead, anticipating the devising of improvement or its much-needed wider application, industry often seems unaccountably slow in taking advantage of new invention or novel application. Then time spins by, and we suddenly find this ground behind us and a new horizon ahead.

Still in restrospect, what coaxing was required to secure the trial and adoption of welding and cutting and their corollary, hard-facing; of alloys that resist corrosion, abrasion, and heat, in their varying combination, or that increase equipment's strength, or lighten its weight, or accomplish both; what reiteration was needed of the great advantages of the diesel engine for many purposes and of the internal-combustion engine in general, especially for the isolated plant; what urging of the possibilities of mechanical loading underground. Yet all these things today have "crashed society," and are now widely recognized as boons to industry, for use where and when conditions call for them—a use that still has great possibilities of expansion.

Considering the present more closely, we see important developments just now getting into stride. Innovations in materials handling in the mining field have gained great impetus, both in conveying and in transport, if the two may be considered separately. In their basic essentials they involve little or nothing that is really new. And that is where the critic might find reason for comment on the slowness of industry at times to employ to its advantage devices already known. Today the Lake Superior Iron Country shows great interest and activity in the application of belt conveying and truck transport to the movement of ore within the pit and from the pit to surface. Various noteworthy installations are to be seen (one is described in this issue) and more are on the way. One hears, in explanation, that the striking use of conveyors for moving earth in building the Grand Coulee dam, in the Northwest, is responsible for this development. No doubt this exercised an influence. But for years previously in the Middle West various sand and gravel operators have used belt conveyors for moving the output from their pits and have appeared to like them. Iron ore is heavier than sand, of course, but the problem is otherwise the same. Conveyors are likewise being put underground in metal mines, but rather hesitatingly it seems, in view of the fact that for years certain coal mining companies in the East, as well as one large metal mine in Mexico, have so used them extensively with success.

Truck transport is as old as civilization—almost. But what trucks we have today—built like battleships, of huge capacity and supplemented with corresponding trailers, all moved on rubber or caterpillar treads, equipped with powerful rugged engines, and capable of being dumped with ease. How slow they have seemed to be in coming, but here they are, ready for the most arduous service, especially when drawn by tractor, modern technology's product of amazing capabilities. In them is well exemplified what has previously been said about realization suddenly overtaking long unrewarded anticipation. Thus industry makes progress.

THE TREATMENT PLANT of Silica Company of California, near Brentwood, Calif., is producing flint and amber sands, silicate sand, and four grades of molding sand for steel foundries. Its situation near the large industrial centers of the Golden State insures it a market for its products



CRUSHING, SCREENING, and CONCENTRATING are done in the buildings in the foreground at the left. Beyond the trestle in the center are storage bins and to the right of them is the acid leaching plant. This view shows the side of the plant opposite to that in the accompanying photograph

A Glass Sand Enterprise On the Pacific Coast

Silica Company of California is making four products in its modern plant from mineral mined underground

John B. Huttl
Assistant Editor
San Francisco

MINING of glass sands in Contra Costa County, Calif., is a relatively young industry. Though the existence of commercial sand deposits in the foothills east of Mount Diablo has been known for many years, and despite periodic attempts to exploit them, it was not until 1930, when the Silica Company of California, Ltd., entered the region, that a product acceptable to glass makers and steel foundries reached Pacific Coast markets. Before this event, Far-Western manufacturers were largely dependent upon materials imported from abroad, principally from Belgium.

The area in which the deposits occur is in the eastern section of the county. Being thus near large industrial centers such as San Francisco, Metropolitan Oakland, Pittsburg, and Stockton, it consequently enjoys the advantages of electric power and natural gas at reasonable rates and adequate rail, water, and highway transportation.

The property of Silica Company of California, Ltd., is about 3 miles southeast of Brentwood, a station on the Santa Fe main line. It is served by several paved branch roads, and rail connection with the treatment plant is made over a short spur. The distance between the mine and treatment plant is less than 3 miles. All mine production is hauled on contract in 10-ton trucks.

The deposit currently under exploitation is of Eocene age and consists of compact sandstones in which occurs a workable bed of amber-colored sand, varying in thickness from 30 to 40 ft., with a dip of 30 deg. Intercalated with the amber-colored sand are tongues of white sands of feldspathic nature. These are avoided as far as possible in the mining operations. The minable sand is sufficiently compact and cemented to permit stoping by the room-and-pillar method. In consequence, comparatively little timber is required. The mining is selective.

The mine is developed by a timbered adit, 6 x 7½ ft. in cross-section and nearly half a mile long. A lower bed of sand now under exploitation is opened up by an incline winze 50 ft. in vertical depth and a haulage tunnel extending the entire length of the minable seam. All mine workings are lighted electrically. Tramming in the upper or main haulage tunnel is done by a Jeffrey trolley locomotive. In the lower tunnel cars loaded from chutes are hauled to the loading pocket at the foot of the winze by a steel cable actuated by an electric-driven double-drum hoist. The silica mined is transferred from the winze pocket to the loading bin, a short distance above the roof of the upper tunnel, by a 1½-ton skip operated by a single-drum hoist. At this point the sand is drawn through a chute into 1½-ton side-dump steel cars, which are hauled in trains (8 cars per train) to the storage bins near the portal.

In stoping, each room-and-pillar measures 20 ft. in width. All drilling is done with electric drills and 8-ft. twisted augers 1½ in. in diameter. For blasting 20 per cent gelatin dynamite is used. The broken sand is transported to the loading chutes spaced at set intervals along the sand bed by steel scrapers operated by slusher hoists. Because of the comparatively shallow depth of the underground workings, water and ventilation offer no problem. The sand broken in the rooms is fairly fine, and as a consequence no crushing is done at the mine. Material stored in the wooden bins at the portal of the adit is loaded into 10-ton trucks and hauled to the treatment plant about 3 miles away. Here the following products are made: (1) Flint and amber sands, (2) silicate sand (98.5 per cent SiO_2), and (3) four grades of molding sand for steel foundries.

The treatment plant, near Brentwood, is noteworthy in that it represents a careful selection of modern equipment and an advanced technology in glass-sand treatment. It

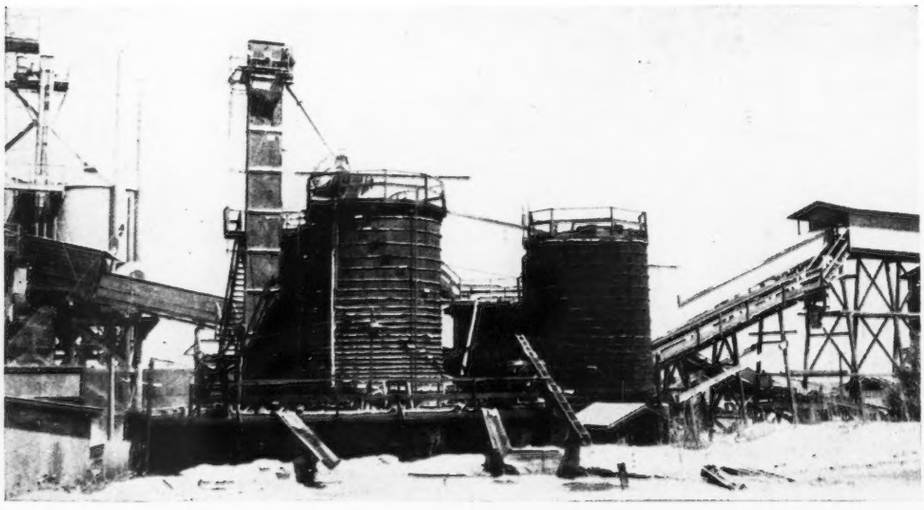
PORTAL of timbered adit, a half mile long and 6x7½ ft. in cross-section, through which this silica mine has been developed

is splendidly designed and constructed, and the machinery contained is so arranged as to offer maximum operating flexibility. The sands produced in the plant as a whole carry a maximum of 1.8 per cent in Al_2O_3, and all materials received from the mine are screened through 30 mesh, with a maximum of 4 per cent remaining on 40 mesh. At the finer end, only 6 per cent will pass the 100 and remain on the 200 mesh. There is practically no minus-200-mesh material. Of the mine feed about 20 per cent must be reduced from plus 30 mesh to minus 30 mesh in either the wet-grinding ball mill or the dry-grinding pebble mill available.

Reclamation from the storage bin at the head of the plant is accomplished by a Traylor vibrating feeder discharging into the boot of a bucket elevator, which in turn raises and dumps the sand over a steel grizzly spaced ¾ in. Grizzly undersize is crushed in a set of rolls and then classified in a Straub revolving screen using 10-mesh phosphor-bronze screen cloth. Water is added at this point. Screen oversize discharged by internal lifters into a steel collector connected to a 4-in. pipe goes to waste, and the undersize flows by gravity to a revolving distributor, and thence to two revolving screens for further classification. These machines are also of Straub make and use 20-mesh phosphor-bronze screen cloth. In design and size they are identical to Screen No. 1. The life of the phosphor-bronze screens is three to four months, as contrasted with about one month of the steel screens used previously.

Oversize from the two revolving screens goes to a steel bin, whence a short belt conveyor directs it to a Straub regrind unit consisting of a ball mill operating in closed circuit with a screen-wheel classifier. The fines from the classifier collect in a steel sump served by a Hydroseal sand pump, which delivers it to a dewatering screw. The dewatered material, an especially high silica sand used for the manufacture of sodium silicate, goes to a storage bin. Undersize from the revolving screens in turn flows by gravity to two Dorr classifiers, the sands going to the concentrating department, containing nine Straub-Overstrom tables, and the overflow to the thickener plant.

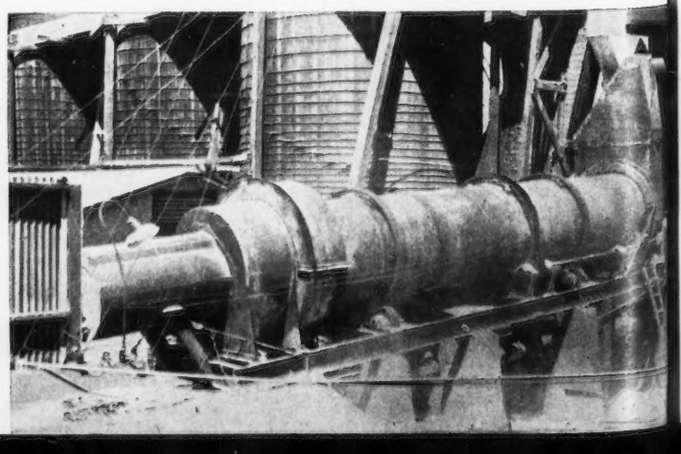
In the concentrating department three types of sand are made—namely, amber, flint, and molding sands. These come off the tables as tailings. The table concentrates, containing objectionable minerals such as ilmenite, zircon, and andalusite, are pumped to the thickener plant. Two mechanical thickeners are available here. Underflow from these units goes to the waste dump and the overflow to the settling ponds adjacent to the acid plant. The three table products, indicated in the accompanying flowsheet as A, B, and C, are pumped separately to respective dewatering units. The amber and flint sands are treated in dewatering screws and an Allen cone is available for dewatering the molding sands. The dewatering screws operate on tracks above the 2,500-ton storage bin. All pumps in this department are of Wilfley make, and the dewatering screws used at different points in the plant were manufactured accord-

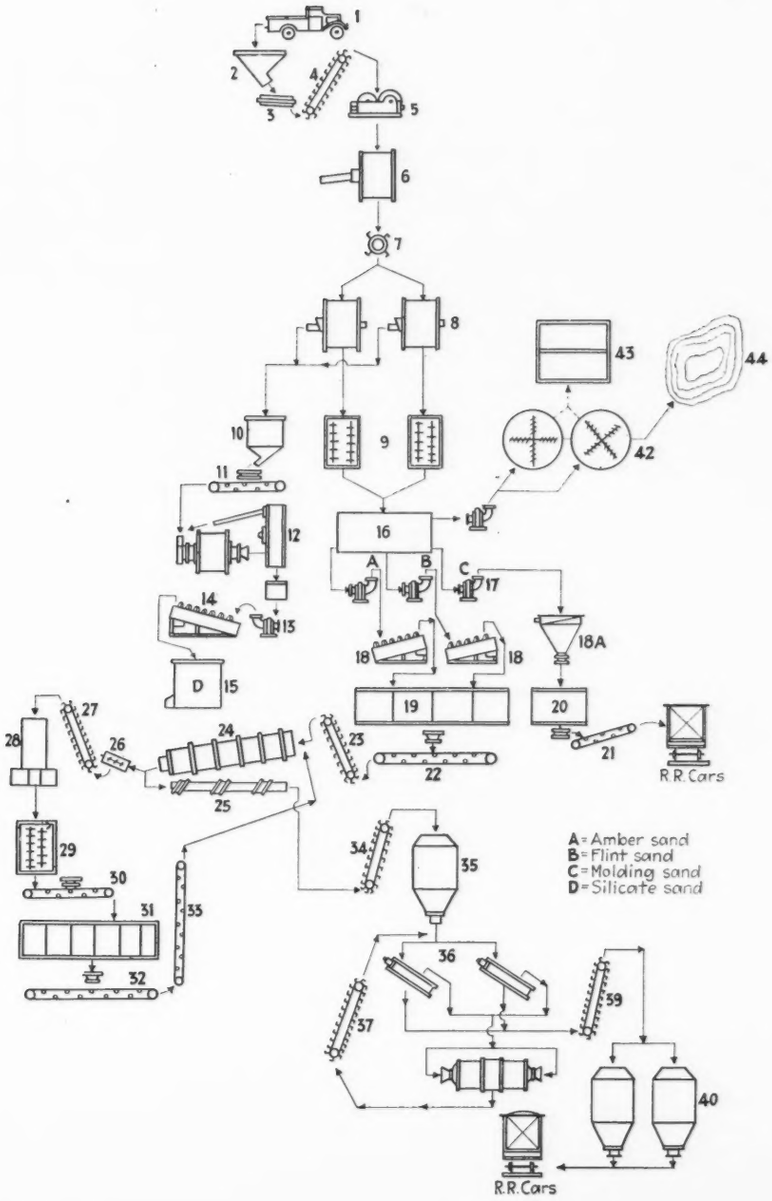


ACID LEACHING PLANT, to which comes iron-bearing material by a screw conveyor after being dried in the rotary dryer. The iron is reduced from 0.14 per cent Fe_2O_3 to 0.035 per cent. The leached sand is again dried and then stored prior to being ground and screened

THE DEPOSIT worked is a bed of amber-colored sand varying from 30 to 40 ft. in thickness and having a dip of 30 deg., here clearly seen in lower left corner

THIS ROTARY DRYER is 5x31 ft. in dimensions and is fired with natural gas. The dried products are removed by either a screw conveyor or a vibrating conveyor, depending on the subsequent treatment





ADVANCED TECHNOLOGY and use of carefully selected modern equipment mark the flowsheet, here presented, of the Silica Company's treatment plant. The accompanying legend explains the numbers

LEGEND

1. 10-ton trucks
2. Feed hopper
3. Traylor vibrating feeder
4. Bucket elevator
5. Rolls
6. Revolving screen (10-mesh screen cloth)
7. Revolving distributor
8. Revolving screens (20-mesh screen cloth)
9. Dorr classifiers
10. Bin with vibrating feeder
11. Conveyor belt
12. Ball mill with screen-wheel classifier
13. Hydroseal pump
14. Dewatering screw
15. 250-ton storage bin
16. 9 Straub-Overstrom concentrating tables
17. Wilfley pumps
18. Dewatering screws
18A. Allen dewatering cone
19. 2,500-ton storage bin
20. 250-ton storage bin
21. Conveyor belt
22. Conveyor belt with portable feeder
23. Bucket elevator
24. 5x31-ft. rotary dryer
25. Traylor vibrating conveyor
26. Screw conveyor
27. Bucket elevator
28. Acid leaching plant
29. Drag washer
30. Conveyor belt with tripper
31. 2,500-ton storage bin
32. Conveyor belt with portable feeder
33. Conveyor belt
34. Bucket elevator
35. Storage bin
36. Robbins vibrating screens (34 mesh)
37. Bucket elevator
38. Silex-lined pebble mill
39. Bucket elevator
40. Storage bins
42. Dorr thickeners
43. Settling ponds
44. Waste pile

ing to specifications by the Stockton Iron Works.

The storage plant holding the amber and flint sands is served by a belt conveyor equipped with a portable feeder, which discharges the material withdrawn from the different bins into the boot of the bucket elevator feeding a Stockton Iron Works 5x31-ft., gas-fired, rotary dryer. Molding sands stored in the 250-ton storage bin are loaded into railroad cars by a flexible conveyor belt. The rotary dryer is served by two separate conveyors. Dried material containing iron goes via a screw conveyor at the discharge end of the dryer to the acid leaching plant, and a Traylor vibrating conveyor and a bucket elevator conduct standard sands to a steel storage bin at the dry screening and regrinding department adjoining the main storage plant.

Material received at the acid plant carries about 0.14 per cent in Fe_2O_3, which is reduced to 0.035 per cent. The contents of the silo-type steel storage bin are passed over two Robbins vibrating screens covered with 34-mesh screen cloth operating in closed circuit with a silex-lined pebble mill. This mill is somewhat of an innovation in that it is fed at both ends with a central discharge. It was built by Straub Manufacturing Company according to specifications supplied by the management. Bucket elevators convey and discharge the pebble mill product over the vibrating screens, and the screen undersize into two silo-type steel storage bins. From these the sands are loaded direct into railroad cars.

Leached sands are treated in a drag washer prior to being sent over a belt conveyor to the 2,500-ton storage plant. From here a portable feeder, conveyor belt, and a bucket elevator return the materials to the rotary dryer. The dried product is sent to the screening and regrinding plant described previously. Current plant production amounts to about 400 tons a day.

A short distance from the acid plant there is a well-equipped laboratory in which raw and finished products are tested. Adjoining it are the repair shops, general office, pumping plant, and warehouse. Equipment in the pumping plant consists of a 1,000-g.p.m. mill pump driven by a 60-hp. motor, a 600-g.p.m. deep-well pump with a 7½-hp. motor, which furnishes make-up water, and two 250-g.p.m. booster pumps driven by a 20- and 15-hp. motor respectively. A Schramm air compressor actuated by a 10-hp. motor furnishes compressed air for the different plant departments. Electric power is obtained from the network of Pacific Gas & Electric Company.

In conclusion I wish to thank K. G. Schwegler, vice-president and general manager of the Silica Company of California, for his permission to publish the foregoing account. The courtesies shown me at the plant by J. Krill, superintendent, are likewise acknowledged.

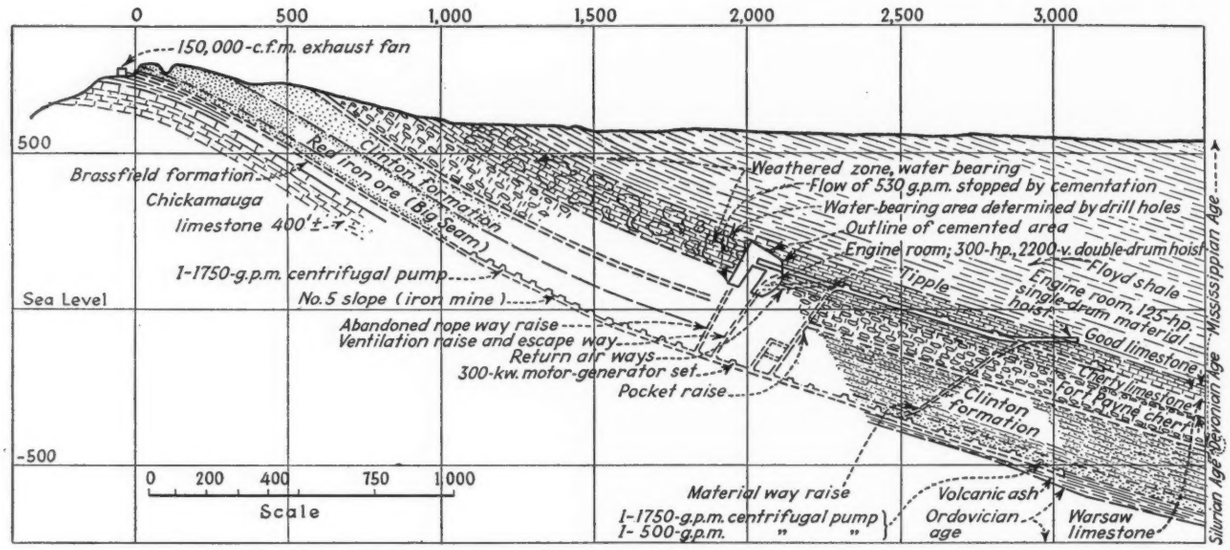


Fig. 1 . . . THE LIMESTONE MINE lies above the temporarily abandoned iron-ore workings of this portion of the Big Seam, dipping under Red Mountain. Access is had through the old No. 5 slope, through which all men, production, and supplies are handled. This cross-section is taken on the center line of the workings

Limestone Mining In Muscoda No. 5

A Unique Underground Operation In the Birmingham District

E. M. Ball
General Superintendent

A. W. Beck
Chief Engineer

Tennessee Coal, Iron & Railroad Company
Subsidiary United States Steel Corporation
Birmingham, Alabama

AT MUSCODA, Ala., 12 miles southwest of Birmingham and a mile southeast of Bessemer, is the No. 5 limestone mine of the Tennessee Coal, Iron & Railroad Company. The property is capable of producing 130 tons of limestone per hour. Of its products, lump stone, 2½ to 7 in. in size, is used in the open-hearth operations at the company's Fairfield steel works. Fine crushed and washed stone, 1¼ to 0.063 in. in size, is calcined at the lime-burning plant and used for lime charges in the open-hearths at the Ensley works. Mine output is shipped to the Fairfield and Ensley plants over the company's own railroad system. The average of analyses of the production for the first seven months of 1937 is given in Table I.

A cross-section on the center line of the mine is given in Fig. 1. The formation in which the limestone occurs is in the Warsaw horizon of the lower Mississippian. It is 130 ft. thick. The limestone beds mined are stratigraphically 330 ft. above the Big Seam of iron ore of the Clinton formation. Immediately above the Clinton and below the workable limestone bed lies approximately 100 ft. of Fort Payne chert, which is composed of layers of chert and cherty limestone. The limestone bed, being badly weathered, is not workable for approximately 1,200 ft. down the dip from the outcrop.

Table I—Average Composition of Limestone Mined, January to July Inclusive, in 1937

Type of Stone	SiO_2 %	Fe_2O_3 and Al_2O_3 %	$CaCO_3$ %	$MgCO_3$, %
Lump	0.60	0.23	98.44	0.22
Crushed and washed . .	0.91	0.29	98.05	0.26

Prior to April, 1931, the limestone requirements of the company were obtained from Vanns quarry, near Trussville, 14 miles northeast of Birmingham. This source of supply was abandoned due to excessive costs, attendant upon a high percentage of waste material in the stone, hand-loading, and high transportation costs.

Extensive diamond drilling undertaken in 1909 to determine the extent, composition, and structural conditions of the iron-ore seam indicated the presence of the limestone above the Big Seam. To prove its extent and grade and to locate the lower limit of weathering, seventeen diamond-drill holes were put down from the surface at Muscoda in 1926. This drilling indicated the presence of a deposit of high-grade limestone 40 ft. thick; also that future developments must be confined to the unweathered stone. The weathered Warsaw and Fort Payne formations at iron mines, where the ore pillars have been extracted in territory underlying the zone of weathering, are heavily water-bearing, as indicated by inflows of over 3,000 g.p.m. for considerable periods.

The temporarily abandoned slope of No. 5 iron mine was used for development of the limestone mine (Fig.

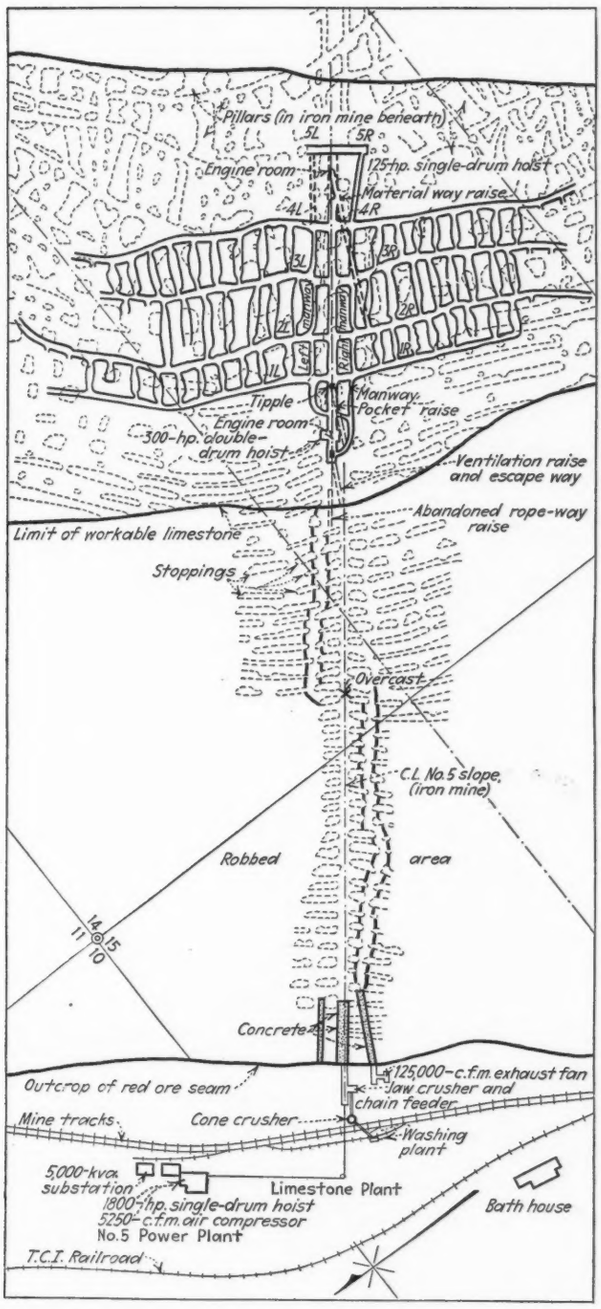


Fig. 2 . . . (left) WORKINGS of the limestone mine are here, in this plan view, seen superimposed over the old iron-ore workings, which are sketched in broken lines. The limestone bed is not workable between the outcrop and a point 1,200 ft. down the dip, owing to weathering

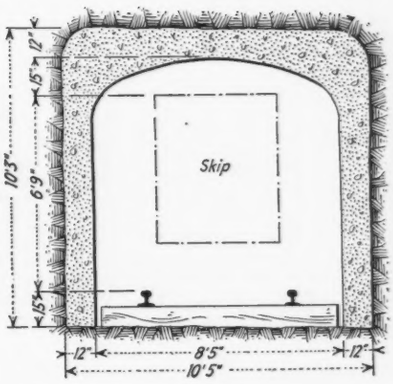


Fig. 3 . . . (top right) A LINING of reinforced concrete, of the cross-section shown here, is provided in No. 5 iron ore slope for a distance of 210 ft. from the portal

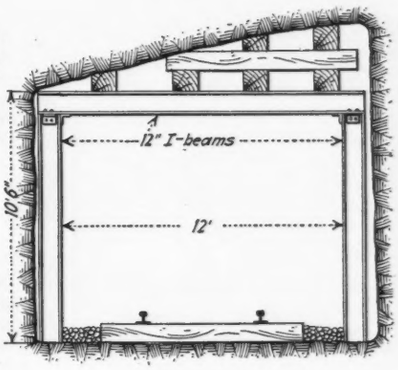


Fig. 4 . . . (right) STEEL SETS such as this are used to support the ground in the ore slope where the ground is heavy

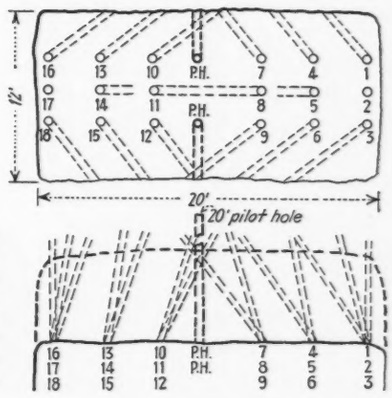


Fig. 5 . . . (right) TYPICAL DRILL ROUND, employing the center cut shown, that is used in advancing level faces and in stopes. Maximum depth of hole is 10 ft. The cut is followed by slabbing rounds

2). Both the limestone bed and the iron ore seam below it have a dip of 17 deg. An 8x12-ft. incline for use as a man-and-material way was raised from the ore slope at an angle of 36½ deg. with the horizontal to intersect the lower edge of the limestone bed. From this intersection, a 10x20-ft. slope was raised a distance of 900 ft. in the base of the workable limestone. Simultaneously, two additional raises were started from the ore slope. The upper raise, which was to be used as a ropeway, was located so as to come below the zone of weathering, as indicated by the diamond-drill cores, and was approximately 2,000 ft. horizontally from the outcrop of the iron-ore seam. The depth of overlying cover at this point was 400 ft. Driving of this raise continued for a distance of 259 ft., or to a point 83 ft. below the limestone bed. At this location, drilling encountered weathered limestone and chert and developed a flow of 530 g.p.m., which made it advisable to stop the work. Work in the lower raise 60 ft. down the ore slope was also discontinued at this time. This raise was to be used as a transfer pocket between the limestone and ore slopes.

Attempts were made to stop the flow of water by cementation, through a series of long drill holes, radiating from the upper part of the limestone slope. After cement had been injected into the area by means of pressure pumps, the inflow of water from the rope raise was reduced to 20 g.p.m. It was found, however, that the territory ahead of the rope raise and the limestone slope was badly weathered. Many cavities filled with mud and clay could not be replaced with cement, making it unsafe to continue work because of the probable inflow of large quantities of mud and water. The ropeway was therefore abandoned after a 12-ft. plug of broken rock was placed in its upper end and filled with cement between the fragments. An inflow of approximately 250 g.p.m. in the upper end of the limestone slope was substantially reduced, after additional cementation work had been done in the back and sides of the slope.

Plans were changed and it was decided to place the auxiliary hoist for handling stone in the limestone slope, instead of in the ore slope below, as intended originally. A new pocket

TEN-TON SKIP entering the single-track tipple at the mouth of Muscoda No. 5 ore slope. The limestone falls into a 125-ton flat-bottomed pocket lined with rails. From this it is fed by a chain feeder to the primary crusher

IN A BACK STOPE. Drilling is under way, with the tripod-mounted machine standing on the muck. The tail block of the scraper used in mucking out the stone is seen fastened to the back

raise was driven from a point 150 ft. down the ore slope. The old pocket raise was completed and used for ventilation and escapeway purposes. The ventilation and pocket raises are both driven on an angle of 60 deg. with the horizontal. Four pairs of mining levels, 12x20 ft. in cross-section, were turned at right angles from the slope. These are placed at 200-ft. intervals and driven on a grade of 1.5 per cent in favor of the load.

No. 5 ore slope is lined with reinforced concrete for a distance of 210 ft. from the portal (Fig. 3). This lining is of single-arch construction with side walls 8 in. thick. The compartment is 8 ft. 5 in. wide and 10 ft. 5 in. high above the top of the ties at the center of the arch. No one is allowed to walk the slope while stone is being hoisted or men and material are being handled. Inspection and maintenance of slope track is done after the shift is finished.

The man-and-material way enters the limestone mine at a point 2,850 ft. on the incline from the portal of No. 5 ore slope. Its intersection with the limestone slope is under 650 ft. of cover. The ore slope, the man-and-material way, and the limestone slope are electrically lighted. To permit signaling, a $\frac{5}{16}$-in. messenger wire is provided in the first two, extending along the left rib of the ore slope and the right rib of the man-and-material way and suspended on insulated hangers. Signals are given with a brass rod, connected by a flexible shunt to the skip in the ore slope, and to the larry in the man-and-material way, respectively. When this is touched to the messenger wire, it completes a 22-volt circuit through hoisting rope and rails, sounding a signal on the hoist engineer's platform. When men are being hoisted in the ore slope, a skip tender is required to ride the front end of the skip with the signaling rod in his hand, so that he can signal the hoist engineer should the necessity arise. When the men are being lowered, the skip tender rides the back end of the skip in a specially provided chair. In hoisting and lowering men in the man-and-material way to the limestone mine, the same procedure is adopted, with the exception that no chair is provided. The man handling the signal rod rides the front end of the larry when it is being hoisted and the rear end during lowering.

Approximately 40 men are handled in the skip on the ore slope and 20 men on the larry in the man-and-material way. Men walk to their respective working places from the lower end of the limestone slope. Materials and mine supplies are handled by special larries in the ore slope and are transferred through the

MINING LEVELS, a face of one of which is here seen, are driven with wet drifters mounted on tripods. A center cut, illustrated in Fig. 5, is used, followed by slabbing rounds. A grade of 1.5 per cent in favor of the load is maintained

material way to the limestone slope. The man-and-material way hoist is a single-drum unit equipped with post brakes and driven by a 125-hp. motor, magnetically controlled.

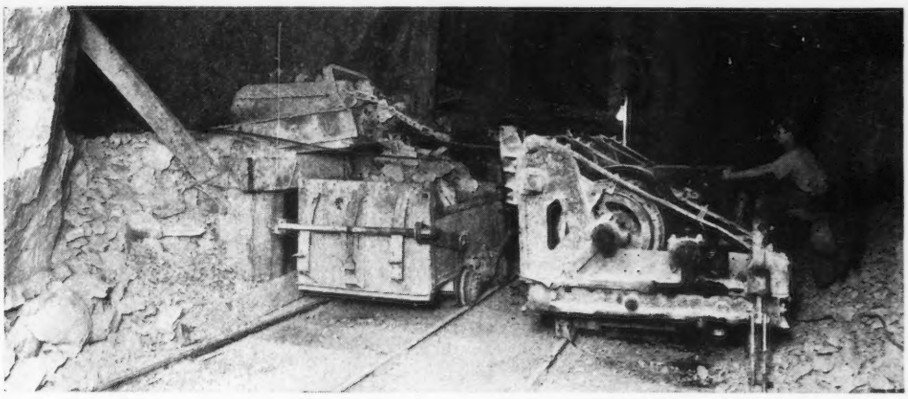
In that part of the ore slope where the top is heavy, support is provided by sets consisting of two legs and a collar framed from 12-in. I-beams. (Fig. 4). In other sections, 12-in. square props are placed on each side of the slope track. No timbering is required in the man-and-material way, but 12-in. square props are used in the center of the limestone slope between tracks.

Drills used for driving the faces of mining levels and in stoping are water-type drifters, having a 4-in. cylinder and weighing 186 lb. For plug drilling and miscellaneous purposes, a light jackhammer-type drill is used. The heavy drills are mounted on tripods and use $1\frac{1}{4}$-in. hollow-round steel. The standard four-point bit is used for all starters; the Carr chisel bit on the longer steels. All drill steel is made up in sets of four pieces each, ranging from 3 ft. to 10 ft., with bit gages ranging from $2\frac{1}{4}$ in. to $1\frac{7}{8}$ in.

A center cut, followed by slabbing rounds, is used in driving levels and stopes, 10 ft. being the maximum depth of hole (Fig. 5 and Table II). Pilot holes 20 ft. long are drilled ahead of working faces, to give advance notice of water-bearing joints or openings. Air is supplied from the 2-in. heading air line through a $1\frac{1}{2}$-in. hose to a line lubricator and through a short section of 1-in. hose to the drill. Water is fed to the drills through a $\frac{3}{8}$-in. hose. The explosive used is a water-resisting ammonia dynamite, in cartridges $1\frac{1}{2}$ x 6 in., with a stick count of 110 per 50-lb. case, and a bulk strength of approximately 42 per cent. All blasting is done with fuse and cap, and only at the end of the shift.

Stope openings 16x12 ft. high are turned off the mining levels on 60-ft. centers. After one of these openings has advanced 20 ft. from the upper rib of the level, it is widened to 30

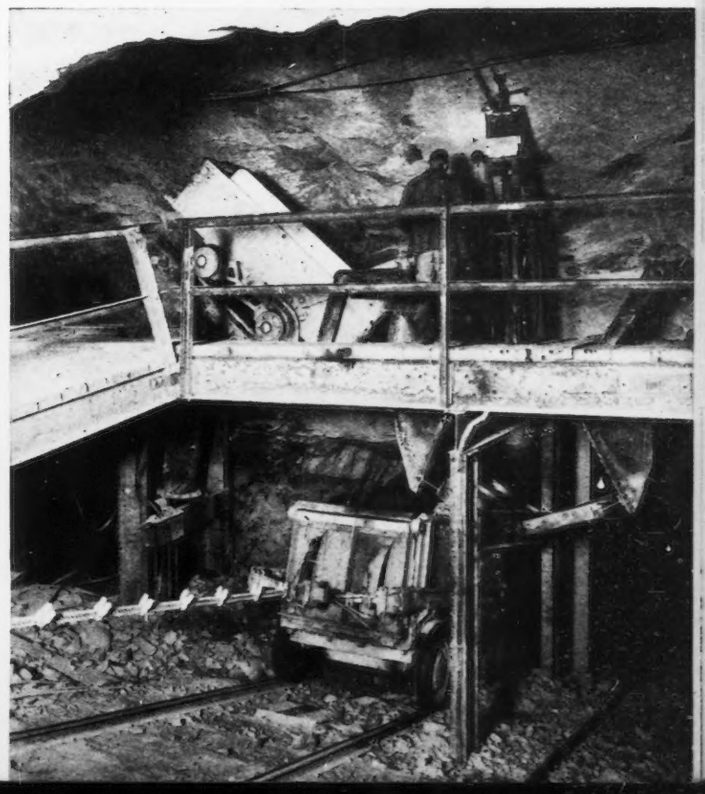
A SIDE VIEW of drilling operations in a back stope. The 20 ft. of limestone remaining in the back after the breast stoping is completed is taken out in two successive cuts



MUCKING LIMESTONE by scraper from a stope into a 3¾-ton mine car on one of the levels. The double-drum scraper hoist is mounted on standard-gage trucks, weighs 14 tons complete, and is driven by a 50-hp. motor

A COMPLETED STOPE. Stopes are turned off the mining levels in the bottom of the limestone on 60-ft. centers. After they are driven to the next level above, 20 ft. of good stone remains in the back, which is then backstoped in two successive cuts. The level interval is 200 ft.

DUMPING one of the 3¾-ton mine cars into a skip of the same capacity on the limestone slope. This is done by means of an air cylinder beneath the tracks



ft. and driven to within 15 ft. of the lower rib of the level above. It is then narrowed to 8 ft. for the remaining distance and broken through near the hanging wall to ventilate the stope properly. Mining levels are driven in the bottom of the limestone bed and 20 ft. of good limestone remains in the back of the stope. This is mined by back-stoping at the lower end of the stope until the lower part of the permanent hanging wall is reached. Sufficient broken stone is left on the footwall to work upon. Back-stoping is then conducted in two successive cuts, each about 10 ft. thick from bottom to top, and advancing from the lower to upper end of the stope. Drilling is done at approximately right angles to the dip. It is not necessary to use wooden staging, as drilling and quarrying are done on top of the broken stone left in the stope. Enough stone is removed to provide working space at the back. All broken stone is removed after the drilling and blasting operations are completed. When the next stope toward the face of the level is broken into the level above, a stopping and adjustable air regulator is placed in the upper end of the worked-out stope. This allows the ventilation to be advanced towards the face of the level and also provides means by which any gas in the worked-out stope can be removed.

All stone in levels and stopes is loaded by double-drum scraper hoists into 3.75-ton standard-gage, roller-bearing, steel tram cars. Scraper hoists are equipped with two loose drums driven through jaw clutches by a 50-hp., 250-volt, direct-current, reversing motor, having contactor controls. The complete scraper hoist is mounted on standard-gage trucks and weighs 14 tons. The front end of the machine is equipped with horizontal and vertical rollers to guide the rope to the drum face. Steel-center ropes, $\frac{7}{8}$ in. in diameter, are used for in-haul and out-haul operations. The scraper itself weighs 2,700 lb., is bottomless, and holds $1\frac{1}{2}$ cu.yd. It is 54 in. wide, 54 in. long, and 34 in. high, with teeth in the back end. In mining, the stone is scraped from the stopes, and the advancing faces over steel loading ramps made from 15-in. channels 18 ft. long and bolted together. The toe of the channel is set in a hitch in the footwall. The other end of the channel extends over the loading track and rests on a 12-in. square timber bent. This bent is placed at proper height for stone from scrapers to fall into the tram cars.

Tram cars run by gravity from the loading ramps to air-operated horn-type tipples placed at the limestone slope. Empties are returned to loading ramps by mules. Tracks are standard gage of 60-lb. rail, laid on 7x9-in. by 8-ft. creosoted ties. Tram cars standing in the air-operated tipples are dumped directly into 3.75-ton balanced skips in the limestone slope.

Skips are handled by a double-drum hoist, driven by a 300-hp. 60-cycle, 2,300-volt, alternating-current motor, operating at 600 r.p.m. through single-reduction gears, to develop a hoisting speed of 1,300 ft. per minute. The drums are 8 ft. in diameter, with a 5 ft. 8 in. face, and are wound with 6x21 $1\frac{1}{8}$-in. lang-lay hoisting rope. The hoist is equipped with magnetic control, hydraulic-control post brakes and clutches, and Lilly hoist controllers with track limit switches and visible skip-position indicator. The engine room for the hoist is located at the upper end of the limestone slope. Skips dump over a double-track steel tipple into the pocket raise to the ore slope below.

Stone is drawn into a 10-ton measuring hopper from the bottom of the pocket by means of an air-operated undercut gate (Fig. 6). The doors in the bottom of the hopper are tripped by an air cylinder. From the measuring hopper, the stone is delivered into a standard-gage, 10-ton skip equipped with roller bearings and three-point suspension. The skip is hoisted, by a single-drum electric hoist, to the surface tipple 2,400 ft. away. A round trip is made in three minutes.

Water from the mine drains to two sumps in the ore slope below, and is pumped to the surface by two motor-driven centrifugal pumps, handling 1,750 g.p.m. and operating in relay. For use in an emergency, a 500-g.p.m. motor-driven centrifugal pump sends water to a main pumping station in No. 4 iron mine.

(To be concluded)

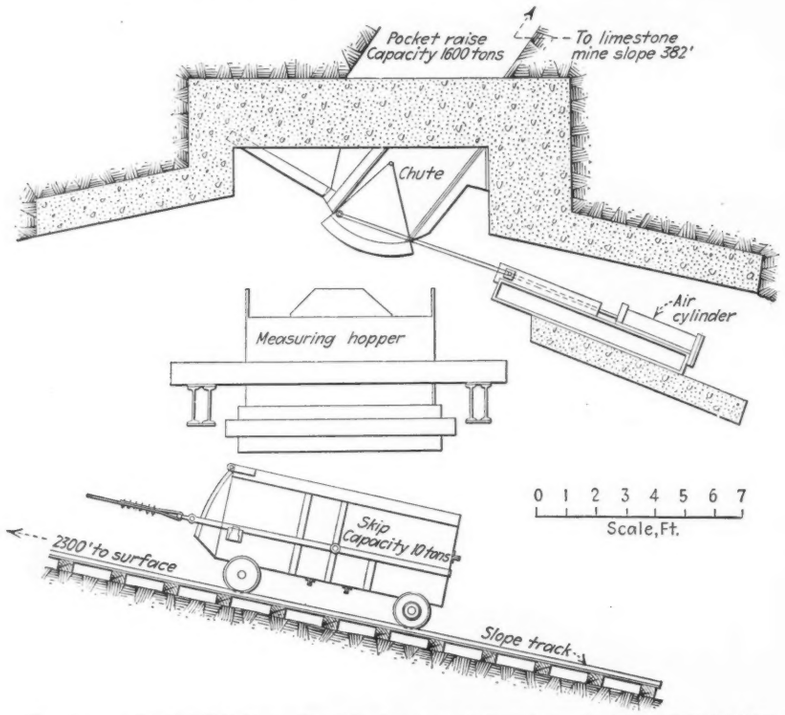


Fig. 6 . . . STONE MINED in Muscoda No. 5 is delivered to a pocket raise holding 1,600 tons, from which it is drawn through an undercut gate into the measuring hopper shown for loading the 10-ton skip that is hoisted on No. 5 ore slope

Table II—Drilling and Blasting Data to Accompany Fig. 5

Kind of Hole	Hole Number	Sticks Powder	Feet Fuse	Number Caps	Sheets Paper	Depth Hole
Upper	1	18	8	1	½	9
Middle	2	12	8	1	½	9
Lower	3	18	8	1	½	9
Upper	4	12	8	1	½	9
Middle	5	10	8	1	½	7
Lower	6	12	8	1	½	9
Upper	7	12	8	1	½	9
Middle	8	10	8	1	½	7
Lower	9	18	8	1	½	9
Upper	10	12	8	1	½	9
Middle	11	10	8	1	½	7
Lower	12	18	8	1	½	9
Upper	13	10	8	1	½	9
Middle	14	10	8	1	½	7
Lower	15	12	8	1	½	9
Upper	16	18	8	1	½	9
Middle	17	12	8	1	½	9
Lower	18	18	8	1	½	9
Totals	18	242	144	18	9	154
Pilot	P.H.	0	0	0	0	20

Compressor Explosions

An Explanation

Any excessive heating should be avoided

Walter S. Weeks
Professor of Mining
University of California, Berkeley, Calif.

DISASTROUS EXPLOSIONS sometimes take place in compressor plants and are due to the fact that the pipe at the discharge of the compressor becomes red hot and ignites the oil vapor in the receiver and air line. A number of years ago a study was made at the University of California to determine the conditions under which the temperatures became dangerously high.[1] The compressor was unloaded by a valve that closed the intake. The machine also had a high-pressure unloader which opened the high-pressure cylinder to atmosphere when the intake was closed. For the period of the tests, the high-pressure unloader was rendered inoperative.

It was found that dangerously high temperatures occurred only when a leak was present in the high-pressure discharge valves and then only if the intake was closed. The high temperature is caused by the air flowing from the line into the cylinder and being recompressed and pushed back into the line. This condition may occur in any machine in which the cylinder is not opened to atmosphere when it is unloaded. The heat accumulates at the discharge of the compressor. If the compressor is delivering air this heat is carried away, so even if the discharge valves do leak, the machine will not become dangerously hot if it is not unloaded.

These are the facts, but at the time of the experiments we had no clear or definite physical explanation of the phenomenon.

An explanation of the high temperatures produced may, I believe, be deduced by an application of some of the principles developed in a recent Institute paper.[2] In this paper it was shown that if air flows through an orifice from a constant-pressure source and does work on the low-pressure side, its temperature when brought to rest is the same as that of the source. It was also shown that if air flows through an orifice from a constant-pressure source into a chamber where it is not permitted to do work, its temperature rises.

Consider the cycle of the compressor with a leaky discharge valve when no air is admitted from the atmosphere. On the suction stroke the hot air flows from the line into the cylinder and, depending on the size of the leak, builds up a pressure in the cylinder and does work driving the compressor. The air expands adiabatically in the leak and cools. This loss of heat goes into kinetic energy and the air has a high velocity in the leak. When the air is brought to rest at the end of the stroke the kinetic energy goes back into heat, so this action causes neither heating nor cooling. The air in the line and receiver expands slightly and pushes the air into the leak at practically constant pressure. This work is balanced by the work done in the cylinder by the air, so no heating or cooling takes place on account of this action. Thus the air at the end of the suction stroke would have the same temperature as when it was in the air line if it were not for the heat absorbed by the cylinder. In any event it will be considerably warmer than the atmosphere.

The compression stroke now begins and the pressure in the cylinder rises until it equals the line pressure. Air continues to flow into the cylinder from the line until the cylinder pressure equals the line pressure. Since the air that flows in can do no work in the cylinder, it is warmer than the line air when its velocity is destroyed in the cylinder. This effect added to the heat of compression causes the air discharged into the line to be at a higher temperature than that of the air that leaked into the cylinder. This hotter air now leaks into the cylinder and on the next stroke is discharged into the line at a still higher temperature. Inasmuch as no air is flowing through the machine, most of this heat appears at the discharge of the compressor, and the time necessary to cause an explosion depends on the relation between the heat developed and that carried away by the water jackets, and radiation and convection from the pipe at the discharge.

If a compressor shows a tendency to heat unduly, the cooling and lubricating systems should first be checked. If the trouble is not there, leaky discharge valves are indicated. The compressor may be operated by rendering the unloading mechanism inoperative and discharging excess air to the atmosphere. This will cause a constant flow through the machine which will prevent accumulation of heat at discharge. The valves should be cleaned and seated at the earliest opportunity. that arises.

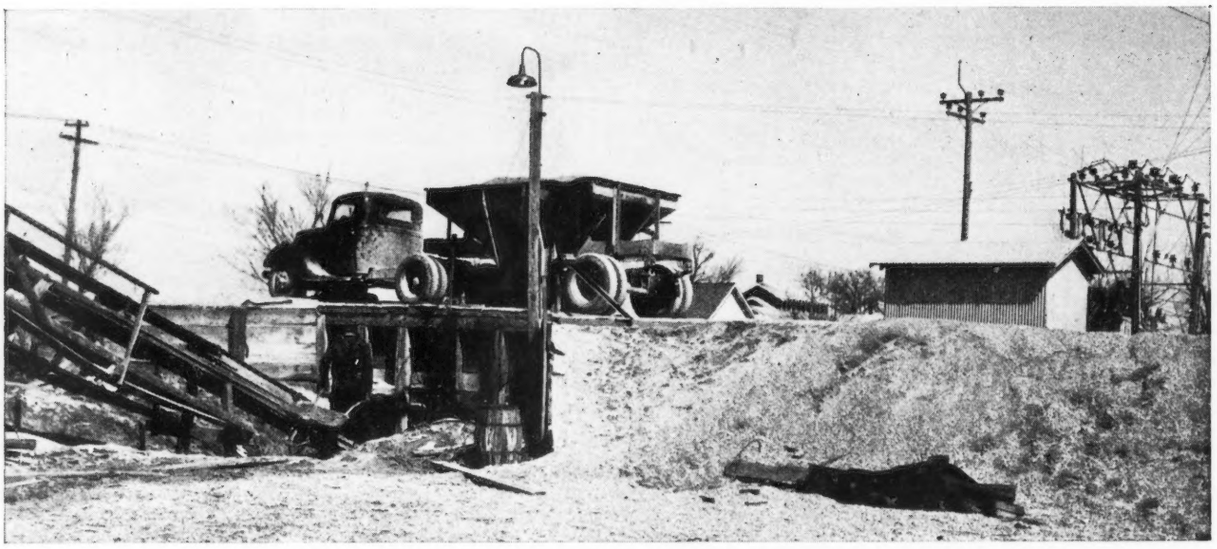
[1] Weeks, W. S., Milisich, C. F., Berteaux, H. LeC.: "A Study of Temperature in a Two Stage Air Compressor," *E. & M. J.-Press*, Vol. 119, May 9, 1925.

[2] Weeks, Walter S.: "Cooling Effect of Compressed Air When Freely Expanded." A.I.M.E. T. P. No. 793, February, 1937.

▼ ▼ ▼

Moving Crippled Mine Cars

A METHOD of transporting damaged mine cars to the shop has been developed by Sherman Lynde, of the Federal Division of the St. Joseph Lead Company, operating in Missouri. The device operates on more or less the same way that a wrecked automobile is hauled from the highway to a garage by a wrecker truck. The photograph shows the manner in which the 15-in. clamps at the bottom of the ⅝-in. chains are slipped over the bottom H-beams of the crippled car and the heavy iron brackets placed in position on the car ahead. By tightening the nuts on the 1-in. eyebolts the damaged end is raised clear of the tracks and hauled away.



UNLOADING TAILINGS into a subsurface hopper at the plant of the Captain Milling Company. A conveyor at the left takes them to a storage hopper

Re-treating Tri-State Tailings

Diverse Methods Account for One-fourth of District's Output

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Mining Engineer
Joplin, Mo.

C. E. Heinz
Metallurgist
Joplin, Mo.

PRODUCTION of concentrates from the re-treatment of tailings in the Tri-State zinc-lead district did not assume sizable proportions until about 1924, when the flotation of Tri-State ores became economically feasible. Tailings re-treatment, however, had its beginnings soon after tailings were available for re-treatment.

Lead was first mined near Granby, Mo., about 1850, and the accompanying sphalerite, or "black jack," had no commercial value, so it was discarded as part of the "tailings" or waste rock. The rich, shallow mines produced ore that was "easy pickins," for much of the galena broke free and could be profitably hand-picked. The attached lead mineral, together with the sphalerite, was discarded.

Hand-picking was a wasteful method of concentration, so it was not long before crushers and hand jigs were employed to increase the recovery of the galena.

The zinc minerals had no value until in the early 'seventies, and as the zinc-lead ratio usually increased with depth, this led to deeper mining and the use of more efficient equipment. As all the zinc mined before this time had been left in the waste piles, most of these piles were reworked by hand jigs to recover the zinc and some of the lead minerals which had previously been lost. As the district increased in size to include Joplin and Webb City-Carterville, in Missouri, and Galena, in Kansas, the deeper mining brought in the "hard or sheet-ground" ores as distinguished from the shallow "soft-ground" ores. By this time mechanical jigs had appeared as a natural evolution of the hand jig, but rich original tailings were still too frequent, for there developed a rivalry, which was too often an enmity, between the ground foreman and the jig man, with the slogan for the ground crew "Get the dirt and cover up the mill!" To keep from being "covered up," the jig man crowded the jigs, with the result that tailings were high in mineral values. These piles were all potential sources for re-treatment, and sometime during later years were re-treated, often several times, depending upon the efficiency of the earlier operations.

The jig man, around the turn of the century, was king of all he surveyed and was often autocratic and hidebound by tradition. Many jig men fought the introduction of the early end-bump or shaking table of the Wilfley type. They were firmly convinced that they were doing a good job of milling and refused to let anyone "show them different." As a result of this attitude, numbers of enterprising individuals contracted for the tailings as they were discarded from the mill, screened out the fines, and ran these fines over tables. The story is told that on several occasions when the jig man saw

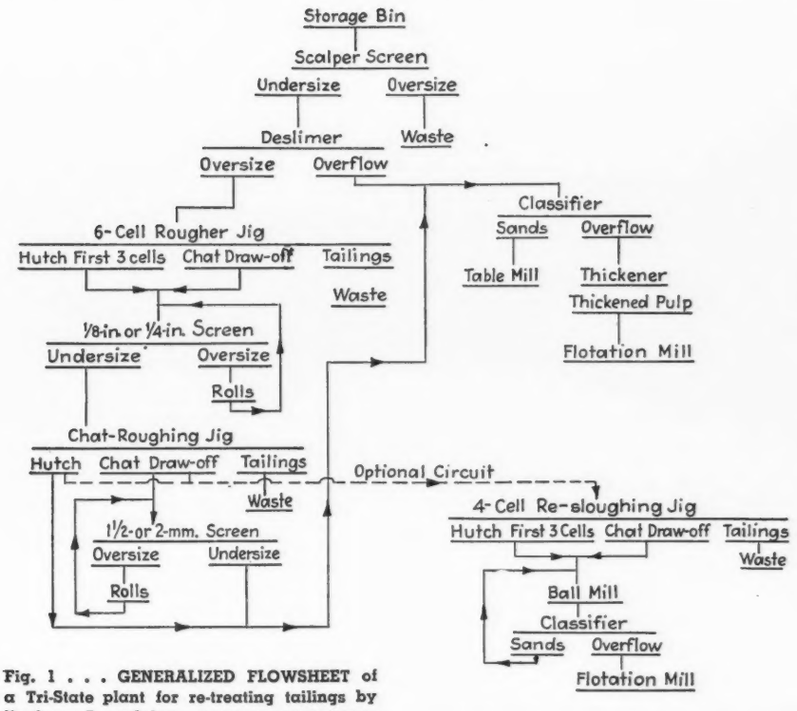


Fig. 1 . . . GENERALIZED FLOWSHEET of a Tri-State plant for re-treating tailings by jigging. A scalping screen removes tramp material at the outset. Deslimers are provided ahead of the rougher jigs and jig products are sized on various screens, the oversize being reground and the undersize deslimed and reconcentrated. Classified sands go to tables (Fig. 2) and the overflow is thickened and sent to flotation (Fig. 3)

the other fellow was making money re-treating the fines over tables, he changed his tailings flume so that the re-treatment plant would be buried if it were not moved.

By 1915 most of the mills in Missouri and other parts of the Tri-State district were using tables, but the rich waste waters settling in the ponds contained values up to 20 per cent zinc sulphide. At this time flotation was introduced in a small re-treatment plant near Oronogo, Mo., but it was not successful and was dismantled. The richer ores around Picher, Okla., were being developed about this time, and by 1918 most of the lean sheet-ground mines in the Webb City-Carterville area were abandoned. For the next few years mining was so profitable and so many new orebodies were being developed that all interest was lost in the re-treatment of tailings.

The year 1921 witnessed the beginning of a slump in business, and many men were thrown out of employment. Many of the mining companies stopped mining and re-ran the tailings they had produced during the previous years of prosperity. The tailings were treated over the crude-ore mills with perhaps the addition of a few tables. Poor extractions were made, for many operators fell into the error of crowding the lean tailings through the mill to show a low cost per ton of heads treated. During this period many small mills were built to treat the sands which had been left impounded during the previous prosperous years. These mills were usually crude affairs and consisted of several tables powered by a small oil engine. The sands were hand-loaded into wagons for transportation to the mill.

The old adage "Necessity is the mother of invention" was at work during these lean years, for much work was done to increase the efficiency of the mills, and after many attempts differential flotation was successfully adapted for use on Tri-State ores. This started the tailings re-treatment expansion, which since 1924 has grown to such proportions that during 1936 over 100,000 tons of zinc concentrates, or 25 per cent of the district's output, came from tailings re-treatment mills.

Re-treatment mills built immediately following 1924 were erected close to the tailings pile being treated and the tailings were transported to the mill by power scraper, but later, with the spread of the idea of centralized milling of crude ore, a system of truck transportation was developed which made possible the erection of efficient central concentrators and the consequent re-treatment of tailings of lower tenor.

Sampling and Estimating—From a previous study it was estimated that there are approximately 200,000,000 tons of tailings[1] scattered over the entire Tri-State district, with about half of this amount in the older Missouri portions of the district. Many of the Missouri tailings will not be amenable to profitable re-treatment, for they were produced from the low-grade "sheet-ground" ores which were for the most part free-milling. In a recent study it has been estimated that approximately 50,000,000 tons of tailings are available for re-treatment which carry on the average 1.10 per cent of zinc blende that can be recovered. At the present rate of production of tailings re-treatment plants—approximately 100,000 tons of zinc concentrates annually—concentrates can be expected from this source for the next five or six years.

Before a tailings pile is leased or bought in fee it is usually carefully sampled, and the tonnage of available tailings is estimated or calculated. Several methods of sampling

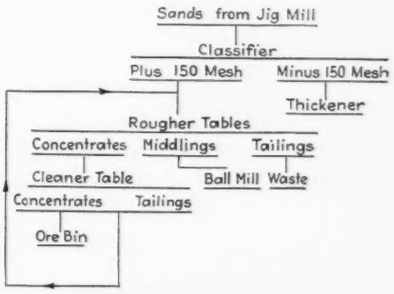


Fig. 2 . . . TABLING PRACTICE is shown here in a generalized flowsheet. Sands from the jig plant (in Fig. 1) are classified, the plus 150 mesh being tabled, the resultant concentrates being cleaned on another table and shipped and the middlings being reground. Tailings are sent to waste

the piles are in vogue. One is to cut trenches into a pile at numerous points and to cut the sample from each trench down carefully to a size suitable for study. Another is to drill shallow holes at intervals over the pile. This is usually done by driving a 2-in. pipe into the pile and removing the trapped tailings with a clay auger. These holes are confined to shallow depths, usually not more than 6 ft., though some operators take only a 3-ft. sample.

The third method is to drill several holes through the pile with a churn drill. To get a representative sample, heavy casing similar to that used in placer prospecting is kept a short distance ahead of the drill bit. Care must be taken not to drive it too far ahead, not over 24 in., or the tailings will pack in it and cause it to be driven through part of the pile without collecting a sample. To avoid losing the fine particles in the sample, which may contain a considerable quantity of free mineral, no water is used. The problem of removing the dry tailings from the inside of the casing has been solved by using a tool similar to the horn-socket fishing

[1] W. F. Netzeband: "Profits From Mine Waste." *E.&M.J.*, Vol. 138, No. 5, pp. 251–254, May, 1937.

tool. This is attached to the end of a sinking bar and worked up and down inside the casing, packing the dry tailings into the socket tool. The dry tailings pack well and can then be raised to the surface and removed by pounding on the socket.

A sufficiently large sample is taken so that a thorough study of the tailings can be made. This usually includes a sink-and-float test as well as a complete screen analysis with assays. Results of the sampling of three tailings piles are shown in Table I.

Many of the mining companies keep an accurate account of all crude ore milled and the concentrates made from this ore. If none of the tailings have been removed from the pile, the tailings remaining should be the crude ore milled minus the concentrates produced. From these figures a fairly accurate estimate of the amount of tailings available can be made. Unfortunately, large quantities of tailings are removed from most of the piles from time to time for various uses[1] so that the figures given in the foregoing may be in considerable error. To obtain an accurate estimate of the tailings pile, transit or plane-table surveys of the pile are made and a contour map is prepared. The cubic contents of the pile are calculated and from this the tonnage of tailings. A study of several tailings piles made by F. J. Cuddeback has shown an average figure of 21.43 cu.ft. per ton for loose tailings.

A theoretical study of a tailings pile preliminary to re-treatment is given below, using the drill samples shown in column 1 of Table I, which is rearranged in Table II to show necessary calculations.

In the calculations the following factors were used: (1) that all blende contained in chats of less than 2.67 specific gravity will be lost; (2) that 40 per cent of blende contained in chats of more than 2.67 specific gravity will be lost; (3) that 10 per cent of blende in minus-35-mesh material will be lost.

Average assay of pile, 3.08 per cent, equals 3.08 tons ZnS per 100 tons of feed.

3.08 — 1.868 equals 1.212 tons in all plus-35-mesh chats.

1.212 — 0.244 equals 0.968 tons in chats having gravity greater than 2.67.

0.968×0.40 equals 0.387 tons lost in chats having gravity greater than 2.67.

1.868×0.10 equals 0.187 tons lost in original minus-35-mesh material.

Total losses:

	Tons
Lean chats.....	0.244
Rich chats.....	0.387
Minus-35-mesh material	0.187
Total loss.....	0.818

Composite tailings assay

$$\frac{0.818}{100 - 3.08} = 0.84 \text{ per cent ZnS}$$

Extraction equals

$$\frac{3.08 - 0.84}{3.08} = 72.7 \text{ per cent}$$

Recovery[2] (making 60 per cent Zn conc.) equals $(3.08 - 0.84)\frac{67}{60} = 2.50$ per cent.

Loading and Transportation—Mills re-treating tailings from a single pile are usually located near the pile and the tailings brought to the mill by a power scraper, often with a belt conveyor for transporting the tailings into the mill hopper. If the pile is some distance from the mill, or several piles are re-treated at the same time, a combination of several methods is employed. Many companies use small gasoline-powered shovels with $\frac{1}{2}$- or $\frac{3}{4}$-cu. yd. dippers for loading into 2-ton end-dump trucks or 8- to 10-ton drop-bottom, semi-trailer trucks. Others use a power scraper for dragging the tailings into a small subsurface hopper, from which point it is conveyed to a surface hopper by a belt conveyor. The tailings are drawn from this hopper into narrow-gage railroad cars or trucks for transportation to the mill.[3]

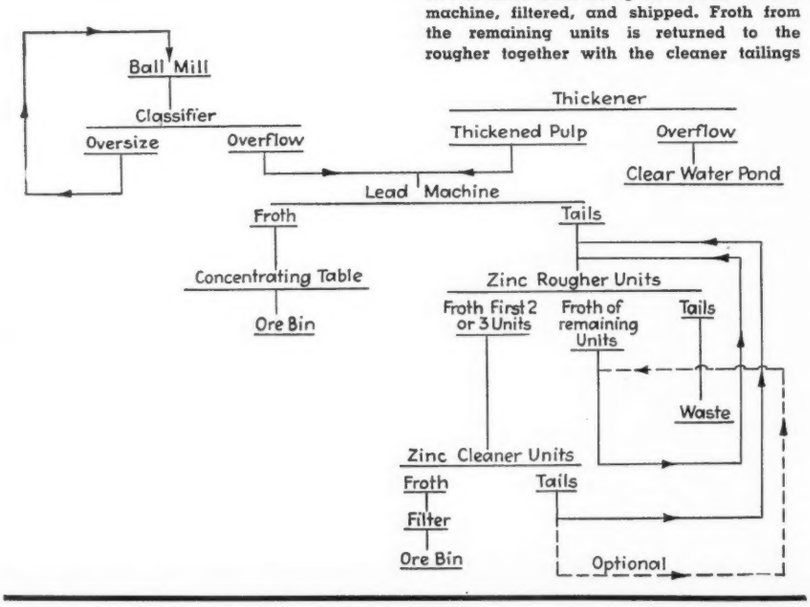
General Flowsheet — The general flowsheet consists of a scalper screen for removing tramp material of all sorts, desliming devices ahead of the rougher jigs, and screens of various types for sizing the hutch and middling products. Oversize from the screens goes to rolls in closed circuit with the screens. The undersize from the screens is deslimed and reconcentrated over chat or slougher jigs. From this point the flowsheets may vary. In one type the middling product from the chat jig is reground with high-speed rolls in closed circuit with a screen. The hutch product from the chat jig joins the undersize from the screen to provide the feed for the tables. Middlings from the tables are ground in a ball mill in closed circuit with a classifier. The overflow from the classifier joins the thickened pulp from the Dorr-type thickener, which has received all the overflow from the deslimers in various parts of the circuit to form the feed for the flotation unit.

The other type of flowsheet further enriches the middling product of the chat jig in another jig, sometimes known as "reslougher," and the hutch and middling product from this jig are sent to the ball mill. Rather coarse flotation is practiced with this type of flowsheet.

One company has eliminated ball mills entirely from the flowsheet, the middlings from the tables being returned to the high-speed rolls.

Rougher Jig Circuit—The feed to the rougher jigs usually receives no other preparation than to remove all tramp material on a scalper screen, which may be a trommel with baffles for breaking up large balls of loosely cemented tailings, or on shaking screens of various makes. All minus-65-mesh material is removed by some sort of desliming equipment. The de-

Fig. 3 . . . FLOTATION PRACTICE in a tailings re-treatment plant is illustrated in this generalized flowsheet. Froth from the lead machine is tabled and shipped. Tailings containing the zinc are treated on a roughing machine, the froth from the first two or three units being cleaned in another machine, filtered, and shipped. Froth from the remaining units is returned to the rougher together with the cleaner tailings



[2] It should be noted that at present the average recoveries from tailings re-treatment plants are 1.25 per cent zinc blende, and it is expected that with better than $40 for zinc concentrates this may be reduced to about 1.00 per cent for economical re-treatment.

[3] W. F. Netzeband: "Surface Transport of Ore and Tailings." *E. & M. J.*, Vol. 136, No. 12, pp. 601–606, Dec., 1935.

sliming equipment consists of either a drag classifier of the Esperanza type or automatic cones of the Boylan, De Meir, or Wood types. Though the operation of the cones is satisfactory, represents a lower initial cost, and does not require any power, the cones require considerably more headroom than the classifier and do not give as regular a feed to the jigs. The homemade drags are not as efficient in the removal of fines and slimes as the factory-made types, such as the Dorr and Akins, but their lower initial cost makes them popular.

The overflow from the desliming equipment should show little if any plus-35-mesh material. This overflow usually passes to large sand drags, where the sand is separated from the slime. This sand goes to make up, in part, the feed to the table department, and the slime goes to slime thickeners for flotation.

The rougher jigs in a re-treatment plant have a twofold purpose: They act as a screen for the removal of the finer sizes of free mineral or rich, heavy "chats," which pass into the hutch, and also recover, by means of suitable draw-offs or "chatters," a middling product which requires grinding for liberation of the contained values. This product makes up the major part of the feed for subsequent treatment. The jig tailing represents from 50 to 70 per cent of the rougher-jig feed.

In a re-treatment plant a larger portion of the rougher-jig feed is drawn off as a middling product than in a crude-ore mill, with a subsequent reduction in the values left in the tailings. The lowest limit to which the values in the tailings can be reduced is an economic problem governed by the cost of treatment of the middlings balanced against the value of the finished product.

The Cooley jig,[4] which is modification of the Harz type, is used almost exclusively in the re-treatment of tailings. In the crude-ore mills, the Cooley jig, with six cells, 42 in. wide by 48 in. long, in series, is usually employed, the fall between cells generally being 3 in. In design the plunger compartment is somewhat larger than the sieve cell, so that the ratio of areas is a little over unity, the common practice being to make the former 4 in. wider than the latter. Ratio of throat area to sieve is less than unity, the usual practice being to make the throat, when measured at right angles to the pitch boards, two-thirds the width of the sieve. The depth of the partition between the plunger and sieve compartments is usually about four-tenths of the width of the sieve cell. The height of the tail board above the sieve level ranges from 6 to 8 in., the former being more common. Hydraulic water is usually added from open launders above the plunger and the sides of the plunger compartment into the hutch compartment.

The speed of the rougher jigs varies from 90 to 120 strokes per minute, with corresponding variations in the length of stroke from 2 in. down to 1 in.

Experience has shown that a six-cell, 42x48-in. rougher jig will handle from 25 to 30 tons per hour of mill feed from which the fine sand and slimes have been removed and produce an economical tailing. The accumulation of top water, however, makes the recovery of the light chat or middlings on the last two or three cells difficult. With the purpose of overcoming this difficulty in tailings re-treatment, different arrangements have been tried, such as feeding a six-cell jig in the middle and dividing the feed to three cells each way, or splitting the feed into as many parts as there are cells, giving the equivalent of single-cell operation. The six-cell split jig has found the most favor and is the one most generally used in tailings re-treatment operations.

Numerous devices have been tried for removing the middlings or chats, but of the many tried the pipe-type seems to work the most successfully, although it is not entirely satisfactory. This type of "chatter" consists of a 2-in. pipe with ¾-in. holes drilled in it on 4-in. centers, or a long slot instead of the holes, placed at the tail end of the cell parallel to the tail board. The pipe is so placed that the holes or slots are at the horizon of the settled chats and facing the direction of flow of the feed. Water, under pressure, is introduced at the back end of the pipe to assist in washing the trapped chats to the outside of the jig wall. Though many chats are trapped, much barren gangue is also trapped, making the middling draw often much leaner in value than desired for subsequent treatment. To maintain the balance between low tailings losses and too much barren gangue in the middling product re-

Table I—Results of Sampling Three Tailings Piles

	1 (a)		2 (b)		3 (c)	
	Per Cent Blende	Per Cent by Weight	Per Cent Blende	Per Cent by Weight	Per Cent Blende	Per Cent by Weight
Original sample	3.08	.....	2.38	.....	3.60	.....
Plus 0.525 in.	.....	None	.....	None	.....	None
Plus 3 mesh	1.46	2.10	0.46	1.30	2.89	6.60
Plus 6 mesh	1.96	18.20	2.35	16.90	2.68	20.30
Plus 10 mesh	1.80	18.00	1.58	24.80	2.16	16.10
Plus 35 mesh	1.75	28.30	2.00	31.35	2.57	25.20
Plus 65 mesh	2.95	11.60	2.00	8.90	3.36	11.40
Minus 65 mesh	7.00	21.80	4.90	16.75	7.55	20.40
3-mesh original	1.46	.....	0.46	.....	2.89	.....
Float on 2.67	0.62	89.73	0.42	98.55	0.60	87.60
Sink in 2.67	8.80	10.37	3.30	1.45	19.20	12.40
6-mesh original	1.96	.....	2.35	.....	2.68	.....
Float on 2.67	0.58	89.76	0.42	89.61	0.57	86.79
Sink in 2.67	14.31	10.24	19.20	10.39	16.62	13.21
10-mesh original	1.80	.....	1.58	.....	2.16	.....
Float on 2.67	0.43	87.32	0.45	89.63	0.42	88.27
Sink in 2.67	11.25	12.68	11.52	10.37	15.45	11.73
35-mesh original	1.75	.....	2.00	.....	2.57	.....
Float on 2.67	0.30	82.70	0.39	85.52	0.36	83.49
Sink in 2.67	8.80	17.30	11.71	14.48	13.92	16.51

(a) Column 1 is a composite of three holes 50, 58, and 68 ft. deep.
(b) Column 2 is a composite of two holes 38 and 52 ft. deep.
(c) Column 3 is a composite of one hole 37½ ft. deep.

Table II—Results of Column 1, Table I, Rearranged

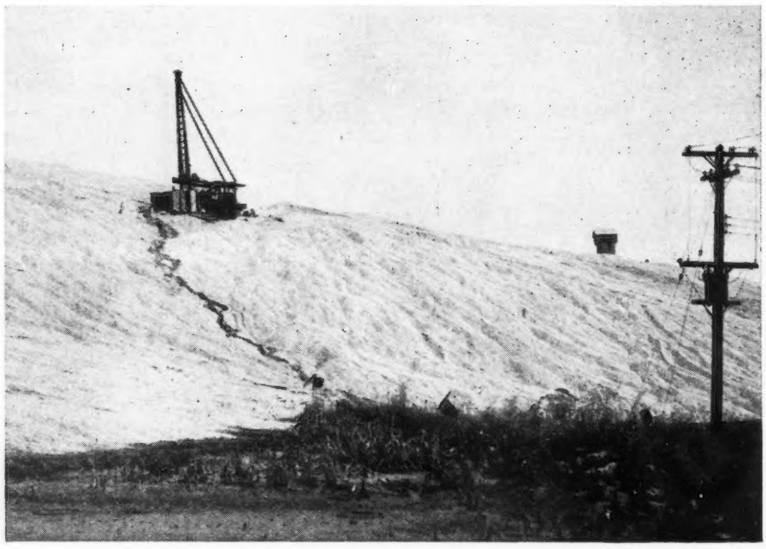
Mesh	Per Cent Weight	Per Cent Float on 2.67	Assay Float, Per Cent ZnS	Tons ZnS in Float per 100 Tons of Feed
Plus 3	2.10	89.73	0.62	0.0117
Plus 6	18.20	89.76	0.58	0.0948
Plus 10	18.00	87.32	0.43	0.0676
Plus 35	28.30	82.70	0.30	0.0702
Tons ZnS lost in float				0.2443
Plus 65	11.60	.....	2.95	0.342
Minus 65	21.80	.....	7.00	1.526
Tons ZnS in minus 35-mesh material				1.868

Calculated tonnage, 361,220 tons.
Estimated tonnage recoverable for re-treatment, 330,000 tons.
Average blende content, 3.08 per cent ZnS.

Table III—Production of Tailings Re-treatment Plants

Year	Zinc Concentrates from Tailings Mills, Tons	Percentage of Total Zinc Production
1929	61,607	9.7
1930	67,939	14.9
1931	41,040	15.3
1932	11,878	9.0
1933	24,251	10.8
1934	62,164	20.7
1935	93,049	25.7
1936	113,537	26.8
8 months 1937	81,165	27.7

[4] Most of the description of the Cooley jig has been taken from the chapter "Milling Practice in the Tri-State Zinc-Lead Mining District." S. J. Burris, Jr., C. O. Anderson, Robert E. Illidge, Warren Howes, and M. D. Harbaugh: A.I.M.E. Transactions, Vol. 112, 1934, pp. 861–924.



SAMPLING a tailings pile with a churn drill. This is one of several methods used. Heavy casing is kept a short distance ahead of the bit

quires careful attention from the jig operator.

Chat-roughing Jig Circuit—There is much divergence of opinion as to the proper procedure for handling the middlings or chats produced by the rougher jig in the crude-ore mills, and as a result many different circuits are in use. As the procedure in the tailings re-treatment mills has been dictated by the experience gained in handling the chats in the crude-ore mills, many different circuits are also in use there. Only two of the more commonly used types of chat circuits will be described.

1. The rougher-jig chats and hutch product are combined and ground to minus $\frac{1}{8}$ in. by chat rolls operated in closed circuit with the chat screen, and the product is deslimed and jigged over the chat-roughing jig. This chat-roughing jig has been referred to in recent literature as a "sloughing jig." This jig produces a rich middling on the first two hutches and a leaner middling product from the chatters, and a tailing for discard. The hutch product of the last cell is combined with the middlings from the chatters and goes to rolls or ball mills operating in closed circuit with the sand screen with $1\frac{1}{2}$- or 2-mm. openings. Middling from the first two hutches is combined with the undersize from the sand screen and goes to tables.

2. A modification of Circuit 1 is to combine the hutch and middling product from the chatters of the rougher jig and crush to $\frac{1}{4}$ in. on high-speed rolls in closed circuit with a chat screen. This product goes to chat jigs, which make a tailing for discard and a hutch and middling product from chatters which are combined and set to a four-cell "re-sloughing" chat jig. The hutch product from the first three cells and the middling chats are sent to a ball mill in closed circuit with a mechanical classifier which overflows a $1\frac{1}{2}$-mm. product. The classifier overflow is combined with the overflow from the various desliming devices and goes to the flotation circuit.

The chat-roughing jig has for its object the elimination of barren chert gangue drawn off by the chatters on the primary roughing jigs, and, in re-treatment plants, that also contained in the hutch product from all cells of the primary roughing jig.

In re-treatment plants this feed represents from 25 to 50 per cent of the original mill feed, this tonnage being dependent in large measure upon the character of the chats recovered by the chatters on the roughing jig. If the mineral values are scattered through a large quantity of lean chats, a large tonnage must be recovered by the chatters in order that a low tailing be sent to discard. Such practice requires that the rougher-jig chat or middlings be reconcentrated for the elimination of the large volume of barren chert necessarily drawn in by the chatters on the rougher jig. To this end this product is usually combined with the heavier chats and free mineral from the hutches and ground to minus $\frac{1}{8}$ or $\frac{1}{4}$ in. in the chat rolls operating in closed circuit with the chat screen. These chat screens are either trommels or some make of vibrating screen (Hum-mer, Leahy, or similar types). Undersize of the chat screen is then deslimed either in automatic cones or drag classifiers of the Esperanza type. Sands from the desliming devices make up the feed to the chat-roughing jig. The roll grind usually liberates sufficient free mineral from the heavy chats to produce a hutch product from the first two cells of a tenor suitable for the cleaner-table feed. The hutch product from the remaining cells, together with the bed draw, or so-called chatter, represents a middling for re-treatment which is handled in a number of different circuits, two of which have been previously described.

The chat rougher-jig tailing eliminated will amount to 50 or 60 per cent of the feed to this jig. The tenor of the middling produced usually is about twice the value of the feed to the jig. Tailings from this jig, after desliming, usually in an automatic cone, are combined with the rougher-jig tailings.

In construction and operating details the chat-roughing jig used in the re-treatment plants does not differ materially from the rougher jig.

Tables—All the overflows from the jigging department and the sands from the chat-roughing jigs pass to a desliming device for separating sands for tabling and slimes for flotation. This device is usually a large homemade belt drag (somewhat similar to the Esperanza drag) or may be several cones, either automatic or with spigot discharge.

Overflow from the desliming device is sent to one or more thickeners to prepare it for the flotation department. Sand discharge goes to a $1\frac{1}{2}$- to 2-mm. screen and from there to some type of classifying equipment. The screen oversize is returned to the chat-jig circuit or may be sent to a ball mill.

The screen may be either a trommel or one of several makes of vibrating screen. Classifiers of the Dorr, Akins, Butchart, the modified St. Joseph, homemade belt-drag types, and ordinary 60-deg. cones with hydraulic water are in use. The prime object of all the classifying equipment is the thorough removal of slime mineral below 150 mesh, although some operators produce eight or more products for as many tables.

The number of tables employed in the mill depends upon the tonnage of original feed and the character of the tailings being re-treated, and may be as many as twenty. The tables make three products: a concentrate, a middling, and a tailing for discard. Concentrate produced is usually sent to a cleaner table and the middling is prepared for flotation in either a ball mill or high-speed rolls.

Usually, the zinc is freed from the chert at 35 mesh. Examination of the various sizes of a table tailing reveals that the coarser sizes that are above 35 mesh have a zinc tenor higher than the sizes from 35 to 150 mesh.

Flotation—Adaptation of flotation to Tri-State ores made the successful re-treatment of tailings possible. In

many re-treatment mills only flotation concentrates are produced, and in the others uually about 60 to 75 per cent of the production is flotation concentrates.

Where tables are used, to produce the best table tailings most of the 150-mesh material is sent to the flotation department. On such a basis of mineral classification, it has been found that the splitting point between flotation feed and feed to the fine-sand concentrating tables lies around 65 mesh for the gangue. Screen analyses of the fine-sand table concentrates and flotation concentrates show that about 150 mesh is the splitting point between the two when measured in terms of grain size of the zinc mineral. Mills producing only flotation concentrates practice much coarser flotation; in some instances all minus 1½-mm. product is sent direct to the flotation department.

Flotation Circuits—Two types of flotation circuits are commonly used in the tailings re-treatment plants, either bulk flotation of zinc or differential flotation of lead and zinc. When sufficient lead is present to justify a lead float, the lead is floated off first and then the zinc, but in most plants there is usually insufficient lead to require an extra machine for this purpose.

The flotation feed is derived from: (1) slimes in the original tailings feed, (2) slimes produced from grinding the jig middling products for re-treatment over chat-roughing jigs, (3) slimes produced in preparing sands for table concentration, and (4) slimes produced from ball-mill operation.

The ball mill is operated in closed circuit with a mechanical classifier, usually of the rake type. Classifier overflow varies from 35 mesh to 14 mesh (minus 1½ mm.) according to the flowsheet being used in the mill. This product joins the thickened pulp, as described subsequently, to form the flotation feed.

Slimes from the other three sources are gathered together in the so-called slime thickener. In general, thickeners 40 to 60 ft. in diameter are used, the number depending upon the mill-feed tonnage. The feed to flotation is generally thickened up to about 25 per cent solids and pumped by means of a 4-in. diaphragm pump to either an elevator or sand-type centrifugal pump and elevated to the lead-flotation machine, or, if no lead is present, to the zinc-rougher machine.

Reagents are generally added just ahead of the first machine, or if the minerals are partly oxidized, the reagents may be added in the boot of the feed elevator to permit a longer time of contact. The usual practice is to float a low-grade lead froth assaying from 30 to 40 per cent lead and pump this entire froth to a concentrating table, where it is graded up to about 60 per cent lead.

Where lead is present the tailing from the lead machine passes direct by gravity into the first zinc-rougher machine, reagents for floating the zinc sulphide being added to the pulp in the tail box of the lead machine. In re-treating tailings it has often been found necessary to allow a longer time of contact with the reagents, in which case the reagents are added to the lead-machine tailings and then laundered to an elevator or pump and from that point are elevated to the zinc machine.

Generally, the practice is to take off about a 57 per cent rougher zinc concentrate from the first few units of the zinc circuit and return the remainder of the froth to the head of the circuit. Then the rougher froth is fed to a zinc-cleaner machine, either by gravity or by means of an elevator or pump. The cleaner machine produces a concentrate of from 60 to 62 per cent zinc. The cleaner tailings are returned toward the head of the zinc roughers.

Usually, the zinc cleaner froth is pumped or elevated directly to the filters without pre-thickening. It generally contains from 40 to 50 per cent solids.

Reagents—The reagents generally used consist of cresylic acid or pine oil for frothers and potassium ethyl xanthate, sodium Aerofloat, or Aerofloat No. 15 and No. 25 for collectors, Barrett No. 634 as a froth conditioner, copper sulphate as the zinc activator, and occasionally a little sodium silicate as a dispersing agent in the recleaning circuit. Under some operating conditions lime is used as a rectifying agent.

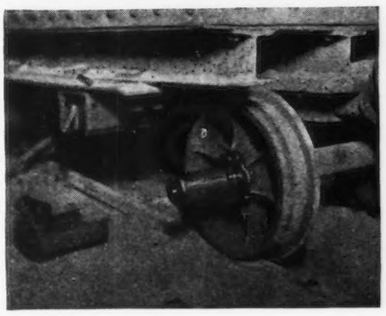
Operating Costs—No detailed operating costs are available, but they vary from 20c. to 45c. per ton of heads treated, the average being about 30c. The cost of handling and transportation of tailings[3] to the mill ranges from 4 to 10c. per ton of heads, depending, in part, on the distance the tailings must be transported. Reagent costs vary from 1½c. to 4c. per ton of heads, which is equivalent to $1.50 to $3.00 per ton of concentrates produced.

Tailings re-treatment plants have increased in capacity from 40 tons per hour in 1929 to 125 tons per hour in 1937, the latter figure being the maximum. The average ranges from 60 to 80 tons per hour. In 1929 there were an average of 20 mills operating and this had increased to 29 in 1937. The number of mills operating had dropped to 3 in 1932 but had recovered to 20 by 1934.

Table III shows the production from tailings re-treatment plants by years and the percentage of the total zinc production derived from that source.

▼ ▼ ▼

Simple Journal Box for Mine Cars



AN EASY REPLACEMENT of a broken mine-car wheel by means of simple design in the journal box has been developed by Roy McDowell, mine foreman at the Federal mine of the St. Joseph Lead Company, at Bonne Terre, Mo. The lower bearing segment of the journal box is fastened to the upper part by a cotter pin and a tongue-and-groove joint. In case of a broken wheel the cotter pin is removed, as shown in the first photograph, and the lower segment of the journal box is removed by sliding along the grooves. The loaded car, raised three or four inches by a jack, permits the upper journal box section to clear the axle. The wheels can then be rolled out from under the car and replaced.

This device avoids delay in running the crippled car to the shop and removing the axle by other methods, as the entire operation of using it requires only a few minutes in which to remove the wheels.

AT THE IRON DEPOSIT in Bulacan Province, Luzon. Many of the boulders in this stream bed are of solid ore. They are gathered by hand and carried on men's backs for about a mile and then transferred to horses or carabaos and taken to the smelter

A Modest Iron Enterprise

Manual operation marks mining and smelting

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AN IRON MINE and smelter in Bulacan Province, Luzon, in the Philippines, furnishes some operating data that are of interest in these days of low-cost, high-tonnage output. The enterprise is based on the Camaching iron deposit, which is near the north end of a bed of iron ore running north and south through the center of Bulacan. The mine is about 40 miles north of Manila. Ten miles to the west is Sibul Springs, where the ore is smelted.

Although iron has been produced in Bulacan for over a hundred years, the present operation had its beginning with a Spanish grant made to Pablo Carlos and Joaquin de la Concha, Sr., in 1879. The furnace at Sibul Springs was built in 1927 by Francisco de la Concha, son of Joaquin, replacing a similar furnace at the mine. The only products are plow points and plow shares, made by pouring the molten iron directly into molds.

In this property the iron occurs in a steeply dipping bed of very hard magnetite and hematite. The sulphur content is often high. A specimen typical of a large proportion of the body ran 67.5 per cent iron and 1.17 per cent sulphur. The formation is 20 to 70 meters thick. The ore is underlain by an igneous complex and is at the base of a great thickness of sedimentary shales and limestones.

Steep mountain streams and heavy rainfall have washed ore boulders down into the stream beds. Oxidation of the pyrite in some of these boulders has removed the sulphur so that the material is soft enough to be broken by hand and pure enough to be charged into the furnace without flux. It is these altered boulders that constitute the commercial ore considered here.

The near-by topography is rugged. Stream beds are narrow and valley slopes steep. The streams are subject to sudden floods, so that road building is wellnigh impossible.

Strictly hand mining is employed. Even shovels are not necessary. The ore is gathered and transported on the backs of men for about a mile. From here to Sibul Springs it is carried on horse or carabao. The customary load for a man is 30 kg. and for an animal, 140 kg. The price paid for mining and transporting ore to the furnace is 4 pesos ($2, U. S. currency) per kilogram. Workmen make about 1.20 pesos per day.

The furnace is a cylindrical stack 6 ft. in diameter by 9 ft. high. It is operated whenever the product from the previous run has been sold; that is, about ten days every month or two. It is relined after every run, this requiring 150 to 190 American firebrick. Charcoal is used for fuel. Coke has been tried, but the resulting iron "is too hot and contains too many bubbles." Blast is furnished by a 2-hp. kerosene engine driving a blower.

Careful books are kept. Figures of a recent eleven-day run are presented. These figures cover practically all the items of cost.

The only taxes are a small levy on the product. The furnace cost 100 pesos. About 2,500 pesos of working capital is necessary.

Table I—Eleven Days' Run—Camaching Furnace

Day	Lb. Ore	Lb. Charcoal
1	364	3,956
2	428	3,956
3	1,142	3,956
4	703	3,956
5	1,268	3,956
6	1,504	3,956
7	1,191	3,956
8	1,358	3,956
9	1,111	3,956
10	1,230	3,956
11	1,191	3,956
Total	11,490	45,516

Product	Pounds
381 first-class plowshares @ 6.6 lb.	2,514.6
361 second-class plowshares @ 4.4 lb.	1,588.4
780 plowpoints @ 5.5 lb.	4,290.0
Total	8,393.0

Table II—Costs at Camaching Furnace—Eleven Day Run

Item	Quantity	Costs: Price	Costs: Total Cost	Costs: Per Pound Product
Ore	5.1 long tons	$20.48	$104.22	$0.0124
Breaking ore	5.1 long tons	1.16	5.95	0.0007
Charcoal	21.75 short tons	7.40	160.95	0.0192
Kerosene for blast	55 gal	0.18	9.90	0.0012
Cores for plow points	780	0.0015	1.18	0.0001
Firebrick	170	0.06	10.20	0.0012
Labor relining	2 man-shifts	0.75	1.50	0.0001
Operating labor				
Master furnaceman	22 shifts	0.75	16.50	0.0020
Moulder	22 shifts	0.75	16.50	0.0020
Common labor	44 shifts	0.50	22.00	0.0026
Cook	22 shifts	0.50	11.00	0.0013
Total cost			$359.90	$0.0428
Receipts				
First-class plow points produced 381 @ $0.60			$228.60	$0.0909
Second-class plow points produced 361 @ 0.40			144.40	0.0909
Plow shares 780 @ 0.30			234.00	0.0545
Total			$607.00	$0.0723
Apparent profit			$247.10	$0.0299

"Velocity of Hit" In Rock Crushing

Some results of a recent study

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WHEN the study of rock crushing dealt with in this article was undertaken, the problem was intended to be an investigation and analysis of rolls crushing, with particular reference to the effect of "velocity of hit" on the nature of the crushing. Much time and money were expended on experimentation with the rolls crusher, but after several months of work this approach to the problem was found unsatisfactory. Consequently, the rolls crusher was abandoned for the time being and "velocity of hit" studies were continued with a drop-weight crusher. Before the latter are considered, a brief record of the results obtained by rolls crushing and a description of the equipment used will be presented.

The equipment included (1) a specially designed rolls crusher, (2) a short conveyor belt which served as a rock feeder, and (3) an integrating watt-hour meter for power measurements.

Construction of the rolls crusher is shown in Fig. 1. This machine consisted essentially of a welded steel frame on which were mounted two long roll shafts. The rolls, 11 in. in diameter with 1-in. faces, were mounted at the ends of the driving shafts as shown in Fig. 1. Near the opposite end the shafts were geared together with two 11-in. machine-cut spur gears. The rolls were driven by means of a pulley on the end of one roll shaft which was connected with a Tex-Rope drive to a 1-hp., 3-phase, a.c. motor. At the gear end the shafts were mounted in ordinary bearings fastened rigidly to the frame, but at the other end they were carried in anti-friction bearings. The latter were not fastened directly to the frame, but were carried on a special bearing assembly suspended from a heavy rod, passing through holes in the upper part of the main frame. A similar rod held the assembly together at the bottom. Adoption of this design had for its purpose the provision of quick and easy adjustment for the

Table I — Net Power (Watts) Consumed in Each Test With Rolls Crusher

Load — Troy Ounces per Minute	Peripheral Speed of Rolls, Feet per Minute			
	835	1,115	1,322	1,567
25	84	108	103	119
50	192	212	234	262
75	262	340	385	443
100	386	415	437	596

Table I-a — Net Power Consumed per Ounce of Rock Crushed per Minute, (Watts)

Load — Troy Ounces per Minute	Peripheral Speed of Rolls, Feet per Minute			
	835	1,115	1,322	1,567
25	3.36	4.32	4.12	4.76
50	3.84	4.24	4.68	5.24
75	3.76	4.54	5.00	5.91
100	3.86	4.15	4.37	5.96

Table II — Screen Analysis of Rolls Products

Mesh	Roll Speed, Feet per Minute: 835 — Load in Ounces				1,115 — Load in Ounces				1,322 — Load in Ounces				1,567 — Load in Ounces			
	25	50	75	100	25	50	75	100	25	50	75	100	25	50	75	100
3/4	6.40	7.70	7.25	7.50	7.80	8.80	6.60	6.80	7.70	3.80	7.10	4.55	6.20	4.00	6.20	4.85
4/6	19.30	21.50	21.50	18.10	19.90	16.80	17.60	18.20	19.20	17.50	17.30	18.25	18.00	14.90	16.60	12.95
6/8	22.90	26.70	22.70	20.25	24.70	23.90	21.10	23.60	27.20	28.20	24.50	25.85	22.50	22.60	21.30	18.95
8/10	16.30	13.80	15.00	16.35	16.20	14.60	16.80	14.60	14.25	16.30	15.80	15.00	15.70	16.10	16.50	16.45
10/14	9.20	8.60	9.65	10.35	8.70	8.90	9.10	9.90	8.25	9.80	9.95	9.30	9.35	11.50	11.10	10.60
14/20	5.50	6.70	5.65	6.45	6.90	7.40	7.10	7.20	6.65	6.60	7.80	7.45	7.60	7.90	8.20	9.90
20/28	4.10	3.90	4.20	4.60	4.60	4.90	4.70	4.70	4.15	4.30	4.25	5.65	5.00	5.40	5.10	6.65
28/35	3.20	2.70	3.65	3.55	2.95	3.50	4.40	3.70	3.00	3.10	3.25	3.20	3.60	3.90	3.40	4.25
35/48	2.70	1.80	2.00	2.35	1.70	2.30	2.10	2.15	1.75	2.10	2.25	2.10	2.65	2.90	2.30	2.70
48/65	2.70	1.20	2.00	2.35	1.25	1.80	2.00	1.75	1.40	1.80	1.50	1.70	2.00	2.10	1.80	2.70
65/100	1.30	1.10	1.10	1.20	1.15	1.60	1.90	1.75	1.20	1.40	1.40	1.60	1.70	1.85	1.55	2.15
100/150	1.20	0.90	0.90	1.05	0.85	1.30	1.60	1.30	0.95	1.00	1.00	1.10	1.40	1.40	1.15	1.70
150/200	1.10	0.90	0.90	0.80	0.90	1.20	1.60	1.30	0.80	1.00	0.90	1.10	1.30	1.40	1.15	1.60
−200	4.10	2.50	4.10	4.95	2.40	3.00	3.40	3.00	3.50	2.90	3.40	3.65	3.50	4.00	3.65	4.60

Elutriation Products of the −200 Mesh Material from Table II

Elutriation Product	835 — Load in Ounces				1,115 — Load in Ounces				1,322 — Load in Ounces				1,567 — Load in Ounces			
E_1	0.570	0.325	0.555	0.553	0.206	0.189	0.235	0.144	0.368	0.316	0.418	0.336	0.368	0.286	0.321	0.456
E_2	0.496	0.325	0.375	0.479	0.227	0.165	0.238	0.182	0.413	0.162	0.375	0.243	0.350	0.200	0.361	0.460
E_3	1.370	0.800	1.220	1.785	0.895	0.845	1.098	0.775	0.937	0.900	0.867	1.331	1.063	1.392	1.192	1.480
E_4	1.640	1.000	1.993	1.990	1.060	1.800	1.800	1.800	1.776	1.481	1.718	1.740	1.698	2.100	1.755	2.190

E_1 = 5.8 microns. E_2 = 11.6 microns. E_3 = 23.2 microns. E_4 = 48.0 microns.

set of the rolls. The two tierods in the bearing assembly were threaded on both ends and provided with lock nuts, by adjusting which the distance between the bearings (and consequently the distance between the roll faces) could be changed by small amounts. The roll shafts were long enough (50 in.) so that the ordinary adjustments for set had no noticeable effect on the shaft alignment.

In the installation described, the driving motor was mounted on an adjustable support welded to the main frame. The same driven pulley was used in all tests, but the motor was provided with several driving pulleys of different diameters, so that the roll speed could be varied. The rolls were provided with a sheet-metal housing, a feed hopper to take the material from the belt-feeder, and a box to catch the discharge from the rolls. This equipment is not shown.

The belt-feeder shown in Fig. 1 was a short length of conveyor belt driven through a speed reducer by means of a ¼-hp. motor. Belt speed was adjusted so that it moved through a distance equal to its own length (half the total length of the belt) in a little over one minute. Inasmuch as the individual tests never lasted more than one minute, sufficient feed could be placed on the belt for an entire test. The feed was spread in the form of a uniform ribbon, and the amount fed per minute could be controlled by varying the width and depth of the ribbon.

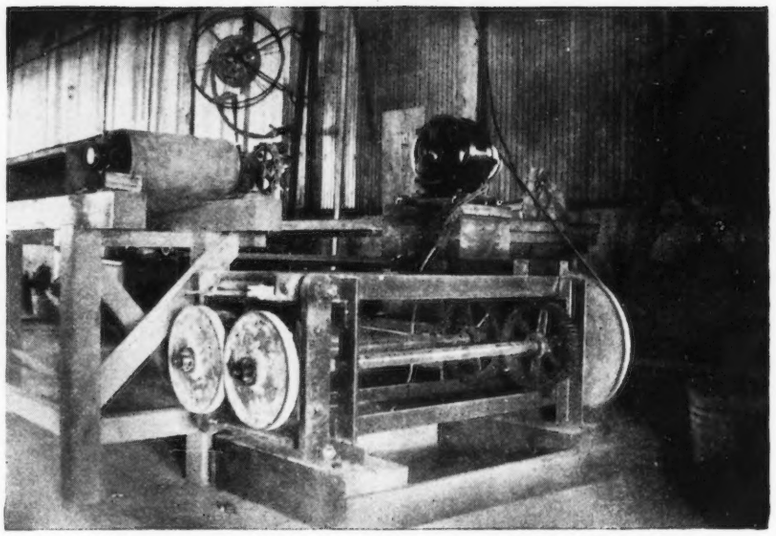


Fig. 1 . . . THE ROLLS CRUSHER used in tests at the outset of the study of rock crushing comprised two long roll shafts mounted on a welded steel frame, each with a roll of 11-in. diameter and 1-in. face on one end, the two shafts being geared together near their opposite ends with 11-in. machine-cut spur gears. The rolls were driven by pulley and V-belt drive

Table III — Surface of Roll Products in Square Centimeters per Gram

Load — Troy Ounces per Minute	Peripheral Speed of Rolls, Feet per Minute			
	835	1,115	1,322	1,567
25	274	162	215	221
50	187	164	188	206
75	250	188	223	211
100	278	156	209	276

Table IV — Variable Height. Constant Weight

Mesh	Velocity of Hit — Feet per Minute						
	336	402	480	540	600	636	668
3/4	58.70	28.18	18.18	14.27	9.35	9.18	16.00
4/6	3.82	16.25	25.80	15.45	16.87	14.82	21.20
6/8	10.50	15.30	11.70	15.50	16.00	24.40	17.10
8/10	8.40	8.49	11.62	12.26	13.14	10.53	12.37
10/14	5.20	8.25	6.90	13.23	13.05	12.06	10.43
14/20	4.65	8.04	6.75	9.52	9.68	8.15	6.00
20/28	3.00	4.20	3.78	6.04	5.25	5.72	4.86
28/35	2.05	4.25	4.62	5.25	6.40	5.12	4.26
35/48	1.64	2.24	2.33	2.65	3.52	3.11	2.11
48/65	0.87	1.62	1.64	2.01	2.40	2.34	1.83
65/100	0.64	1.43	1.27	1.76	1.76	1.99	1.59
100/150	0.38	0.57	0.64	0.73	0.97	0.92	0.75
150/200	0.26	0.36	0.42	0.48	0.59	0.50	0.55
=200	0.28	0.42	0.62	0.84	1.10	1.05	1.06

Constants: Diameter of marble, 0.650 in. Set, 6/16 in. Drop weight, 4.36 lb. Ratio of reduction, $\frac{0.650}{0.375} = 1.74$.

Table V — Variable Height. Constant Weight

Mesh	Velocity of Hit — Feet per Minute			
	336	480	600	668
3/4	44.05	61.00	17.20	7.92
4/6	32.00	10.20	26.40	21.10
6/8	11.04	9.43	20.20	21.22
8/10	3.72	4.97	10.20	10.90
10/14	3.11	5.36	7.90	8.10
14/20	1.57	2.53	5.23	6.95
20/28	1.00	1.87	3.95	4.83
28/35	1.22	1.61	3.51	4.80
35/48	0.61	0.84	1.84	2.46
48/65	0.52	0.70	1.29	1.92
65/100	0.38	0.56	1.03	1.42
100/150	0.21	0.31	0.57	0.80
150/200	0.13	0.21	0.32	0.48
−200	0.23	0.31	0.46	0.76

Constants: Diameter of marble, 0.625 in. Set, 5/16 in. Drop weight, 4.36 lb. Ratio of reduction, $\frac{0.625}{0.311} = 2.00$

Table VI — Variable Weight. Constant Height

Mesh	Per Cent of Crushed Marble Weight of Shoe in Pounds			
	4.36	6.00	6.73	8.40
3/4	59.00	29.35	15.37	31.47
4/6	8.37	23.67	31.17	17.87
6/8	8.37	15.80	14.97	17.87
8/10	6.06	10.10	7.62	4.97
10/14	6.10	9.01	8.00	8.48
14/20	3.77	3.66	4.27	5.27
20/28	2.25	2.31	2.80	3.26
28/35	2.25	2.38	2.98	3.69
35/48	1.20	1.09	1.69	2.13
48/65	0.95	0.84	1.41	1.62
65/100	0.71	0.61	1.21	1.40
100/150	0.34	0.32	0.56	0.79
150/200	0.25	0.23	0.39	0.51
−200	0.46	0.50	0.64	0.79

Constants: Diameter of marble, 0.629 in. Set, 5/16 in. Velocity of hit, 480 ft. per minute

An integrating, polyphase, watt-hour meter, which measured the power input to the motor, proved satisfactory for measuring power. A Prony brake calibration provided the means of determining the power output at the driving pulley.

Technique of an Individual Test—Before a test was made, the motor was run idle for an hour to bring it up to running temperature, and just before each test a power reading was taken with the rolls running empty. A similar reading was taken immediately after each test, and the two were averaged to give the dead-load power reading. This was then deducted from the reading obtained during a test to give the net power consumed in crushing. The watt-hour meter was mounted on a table near the roll assembly, and beside it was the switch which controlled the belt-feeder. The operator would first load the feeder with the required amount of rock and then take up his position in front of the meter where he could start the feeder and take a power reading throughout the entire crushing period. After the run was completed, the crushed product was removed and a sample taken for screen analysis.

The method used in taking power readings may be of interest. The meter which was available was an ordinary polyphase, watt-hour meter designed for recording relatively large amounts of energy—the smallest reading on the recording dials being 1 kw.-hr. Power consumed by the rolls during a one-minute run was far too small to be noted on the indicating dials, and it was necessary, instead, to note the number of revolutions of the disk on the armature. Instead of try-

Table VII — Results of Tests With Drop-Weight Crusher

Weight, 4.59 lb. Set, 0.000 in. Feed, 14/20 Ottawa Sand, $D/d = \infty$

	K.E.,[1] ft.-lb.	2.29	4.59	6.88	9.18	10.32	12.62	Surface per 100 Grams, Sq. Cm.					
	Vel. of hit [2]	340	482	590	684	724	798	340	482	590	684	724	798
	Gm. recovered	4.911	4.911	4.917	4.898	4.887	4.920						
14/20		2.70	0.85	0.45	0.14	0.14	0.37	61.0	19.2	10.1	3.2	3.2	8.3
20/28		7.34	3.26	1.16	0.49	0.41	0.87	233.0	103.7	36.9	15.6	13.0	27.6
28/35		29.90	21.10	16.45	12.86	10.71	10.95	4,180	2,955	2,300	1,800	1,500	1,532.0
35/48		17.20	17.93	16.86	16.18	15.10	14.53	3,035	3,165	2,975	2,855	2,665	2,565
48/65		12.73	15.65	15.45	15.60	15.20	15.36	3,100	3,710	3,660	3,700	3,600	3,640
65/100		11.00	13.83	14.66	15.82	15.73	15.39	3,460	4,355	4,610	4,980	4,955	4,850
100/150		6.25	8.35	9.28	10.23	9.66	9.90	2,660	3,560	3,950	4,360	4,110	4,220
150/200		4.71	6.26	7.44	8.71	8.71	8.33	2,580	3,430	4,060	4,760	4,770	4,555
200/230		0.47	0.63	0.35	0.80	0.33	0.31	331	444	246	563	232	218
230/270		2.34	3.80	4.82	4.90	4.39	4.26	1,900	3,080	3,915	3,980	3,561	3,465
270/325		1.77	2.62	3.44	3.35	6.02	6.15	1,645	2,440	3,200	3,115	5,600	5,720
325/400		0.95	1.71	1.54	1.59	2.76	2.44	1,049	1,890	1,700	1,755	3,045	2,690
	−400	1.99	4.34	6.02	7.26	10.42	10.52	3,000	6,900	11,120	13,580	21,220	21,420
	+400	.....	.....	.....	.....	.....	.....	24,234.0	29,151.9	30,663.0	31,886.8	34,054.2	33,490.9
	Totals	99.35	100.33	97.92	97.93	99.58	99.38	24,974.0	33,792.0	39,523.0	43,206.8	53,014.2	52,650.9
40 Microns		56.50	35.55	26.05	24.50	19.60	22.18						
35 Microns		16.60	20.40	17.48	21.90	19.75	14.95						
30 Microns		16.42	25.70	13.73	13.80	12.40	9.35						
25 Microns		4.31	6.19	20.65	11.95	19.13	24.30						
20 Microns		3.30	4.42	8.09	12.20	7.32	11.05						
15 Microns		1.48	3.73	5.81	7.71	7.70	7.56						
10 Microns		0.91	2.61	5.88	5.36	11.18	7.08						
5 Microns		0.46	1.09	1.86	1.96	2.29	3.11						
2.5 Microns		0.07	0.27	0.40	0.56	0.61	0.62						
	Totals	100.05	99.96	99.95	99.94	99.98	100.20						
% ÷ Wt.		20.3	20.35	20.35	20.35	20.30	20.35						
S/Gm		1,505.0	1,583.0	1,845.0	1,875.0	2,040.0	2,040.0						
% of total		12.0	20.3	28.2	31.4	40.0	40.6						

[1] Kinetic energy, foot-pounds.
[2] Velocity of hit.

ing to determine the exact number of revolutions (and/or fraction of a revolution) in a given time, it was much simpler to find the exact time required for one, two, or three revolutions of the disk by means of a stop watch. From the meter constant, it was then easy to calculate the power input to the motor. All meter readings were converted to "motor output" by means of the curve plotted from the Prony brake calibration.

Experimental Data—The feed used in all of the crushing tests was a gravel containing about 90 per cent quartzite and 10 per cent granite. Only one size of feed was used, closely sized gravel having an average diameter of $\frac{5}{16}$ in. The set of the rolls was $\frac{5}{32}$ in. in all cases, so that the reduction ratio was 2 to 1. Sixteen tests were made, using four roll speeds and four different loads at each of the speeds. Table I gives the roll speed, load, and net power consumption in the various tests. Table I-a gives the power in watts per ounce of rock crushed per minute for each of the tests.

Tables I and I-a show that in general the net power consumption per unit of rock crushed increases as the speed of the rolls increases. The variation is erratic, however, and does not lead to any definite conclusions concerning the relation between power consumption and roll speed. The variation of power consumption with the load is even more erratic (Table I-a).

Each of the crushed products was sized, using the $4\sqrt{2}$ Tyler scale, and — 200 material was sized by elutriation into four products. Data are presented in Table II. Examination of Table II fails to reveal any definite trends which would show the effect of "velocity of hit" (speed of the rolls) on the nature of the crushed product. This is brought out more clearly in Table III, in which is given the surface of each crushed product in square centimeters per gram. These surfaces were calculated by applying Gross and Zimmerly's data [1] for quartz to the sizing analyses given in Table II.

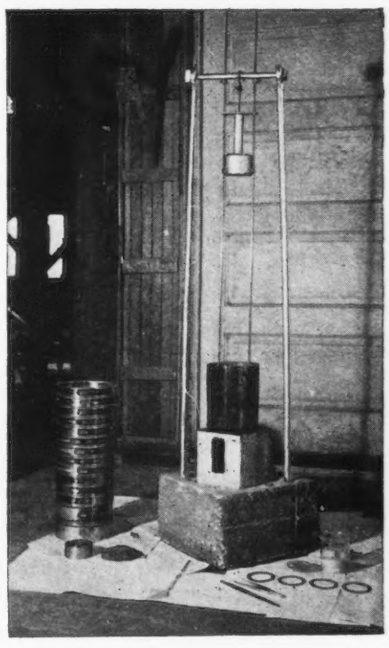


Fig. 3 . . . A CELLULOID COLLAR was made to fit snugly around the die of the drop-weight crusher to prevent loss of the crushed material. See also Fig. 2

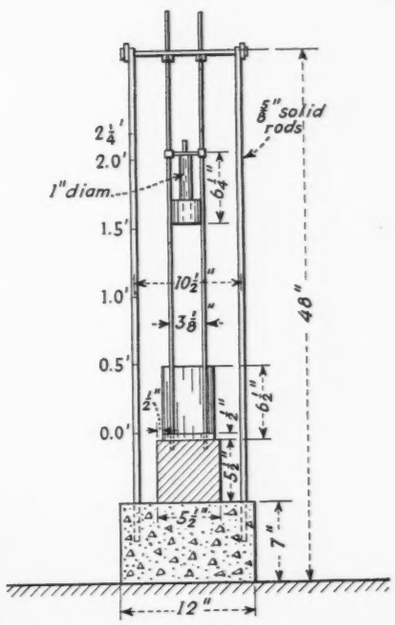


Fig. 2 . . . THE DROP-WEIGHT CRUSHER used in the experiments described comprised essentially a cast-iron die on a concrete base and a steel shoe that could be raised and dropped on parallel guide wires. The same equipment is shown in the photograph reproduced in Fig. 3

The surfaces figures in Table III show that there is no apparent relation between roll speed and the nature of the crushed product. This erratic variation in screen analysis (Table III) and power consumption (Table I) indicated that the roll crusher was not the proper instrument for the study of the effect of velocity of hit on crushing, at least not in the range in which these studies were conducted. To continue the study of this problem, a simple drop-weight crusher was designed, and the results obtained in its use are presented in the following.

Drop-Weight Crushing Apparatus—The drop-weight crusher used in

these experiments is shown by the diagram in Fig. 2 and the photograph in Fig. 3. It consisted of a heavy cast-iron die mounted on a concrete base, and a steel shoe, or drop-weight, riding on two parallel guide wires. The top of the die and the bottom of the shoe were covered with a layer of stellite $\frac{1}{8}$ in. thick to minimize deformation of the crushing surfaces. The apparatus was set up on a concrete floor and adjusted so that the surface of the die was level and the guide wires were perpendicular. A celluloid collar was made to fit snugly around the die (Fig. 3) to prevent loss of crushed material.

Variables

In the studies made, both the height of drop and the weight of the shoe could be varied. A number of metal collars were made to slip over the upper part of the shoe and increase its weight. Some of these were of lead and simply rested on the shoulder formed by the lower part of the shoe; others were of steel and were fastened securely to the lower part of the shoe by means of two machine screws.

The "set" of this crusher was regulated by means of "set rings." These were small metal rings with an outside diameter slightly smaller than the diameter of the shoe. The set ring was placed on the die and centered so that the shoe would strike it squarely, and the material to be crushed was placed on the die inside the set ring. The difference between the diameter of the material to be crushed and the thickness of the set ring then governed the distance through which the crushing action extended or the "stroke" of the crusher. It was customary to denote the diameter of the particles by D and the thickness of the set ring by d; the ratio of reduction was then given by the expression D/d, and this notation is followed in all tabulations and graphs. The expression $D/d = \infty$ means that no set ring was used. Fig. 3 shows both the lead and steel weights and the set rings used in crushing Ottawa sand.

Procedure—It was evident from the start that to obtain satisfactory results in a crusher of such small capacity as the drop-weight machine, the material to be crushed must be of uniform size and shape. In the first series of tests, glass marbles were used. The second series of tests was made on — 14 + 20 mesh Ottawa sand, and one test was made in which the material to be crushed was — 8 + 10 mesh garnet sand. The glass marbles were almost perfect spheres and were uniform in diameter, and the Ottawa sand and garnet grains were approximately spherical in shape.

In crushing the glass marbles, only one marble was used at a time, and the crushing was performed with a single drop of the shoe. In crushing the sand grains, one gram of sand was weighed out and spread evenly over the die and this was crushed by a single blow of the shoe. The crushed material was then carefully brushed off the shoe and another gram of sand was crushed, using the same weight and height of drop, and the crushed material was mixed with that from the first test. This process was repeated five times for each set of conditions, so that 5 grams of crushed material were available for screen analysis.

The glass marbles used averaged about 0.64 in. in diameter and weighed about 6 grams apiece. Loss in crushing and screening amounted to about 1 per cent of the weight of the marble. Two set rings were used with the marbles, having thicknesses of $\frac{5}{16}$ in. and $\frac{3}{8}$ in. respectively. After a marble was crushed, the material was carefully swept off the die and screened, using the $\sqrt{2}$ Tyler screen series. Tables IV, V, and VI contain the data obtained from crushing the glass marbles.

The crushed Ottawa sand and garnet sand were carefully screened down to 400 mesh, and the — 400 mesh material was sized microscopically. The diameter of the Ottawa sand grains averaged 0.0394 in. and the garnet grains 0.079 in. Four set rings were used in the experiments on sand crushing, having thicknesses of 0.005, 0.010, 0.015, and 0.020 in. respectively. Crushing and screening losses averaged about 1.5 per cent. Table VII gives the complete screen analysis and surface data for one set of tests on Ottawa sand. Space limitations prevent the complete tabulation of all the data secured in these crushing tests, and the rest of the data are presented in graphical form in the various figures.

An Explanation

Before proceeding to the discussion of the curves, it will be necessary to explain briefly the methods used in calculating (1) the velocity of hit and kinetic energy of the shoe, and (2) the total surface of the crushed material.

The guide wires were kept well lubricated and they offered little resistance to the falling shoe; likewise, the resistance of the air was negligible considering the relatively large mass of the shoe and the short distance of fall. All friction factors were therefore neglected, and the velocity of hit and kinetic energy were calculated from the weight of the shoe and the height of drop by using the simple laws which apply to the case of a body falling freely in a vacuum. Velocities are given in feet per minute, and kinetic energy is recorded in foot-pounds.

All surface calculations were based on the data of Gross and Zimmerly for the surface of crushed quartz. The figures used in this paper are taken from a summary published by Gross.[2] For lack of more complete data, these figures were used not only for the quartz (Ottawa sand), but also for the crushed glass marbles and the garnet sand. The surface figures given for the latter substances are therefore not to be regarded as absolute measures of the surfaces, but it seems reasonable to assume that they should be proportional to the true surfaces.

Screening After Crushing

All crushed materials were carefully screened by hand, using screens in the Tyler standard series. Each size fraction was weighed and its surface calculated. Where screen fractions were obtained which were not listed in the table given by Gross,[3] the surface values were obtained by interpolation. The total surface of any sample was then obtained by adding the surface figures for each of the size fractions.

Relatively little fine material was produced in crushing the glass marbles, so these products were screened to 200 mesh and the arbitrary figure of 4,000 sq. cm. per grain was assumed for the surface of the — 200 mesh material. The crushed quartz and garnet, however, were screen-sized to 400 mesh, using all available fine screens (see Table VII), and the — 400 mesh was sized microscopically. In this microscopic sizing, a slide was made of a representative sample of the — 400 mesh product and about 500 grains were counted in each slide. The average diameter was estimated to the nearest 5 microns, and the data were tabulated to show the number of particles averaging 40 microns in diameter, the number averaging 35 microns, and so on down to the smallest group with an average diameter of 2.5 microns (see TableVII). Then the relative weight of each size group was computed on the assumption that the mass of the particles varied as the cube of the diameter, and finally a surface figure for each size group was obtained by interpolation in the table given by Gross.[4] In this way the surface of the — 400 mesh material could be approximated with reasonable accuracy.

(To be concluded)

[1] Gross, John: "Summary of Investigation on Work in Crushing." *Trans*, A.I.M.E. Vol. 112, pp. 116-129 (1934).

[2] Gross John: *Op. cit.*

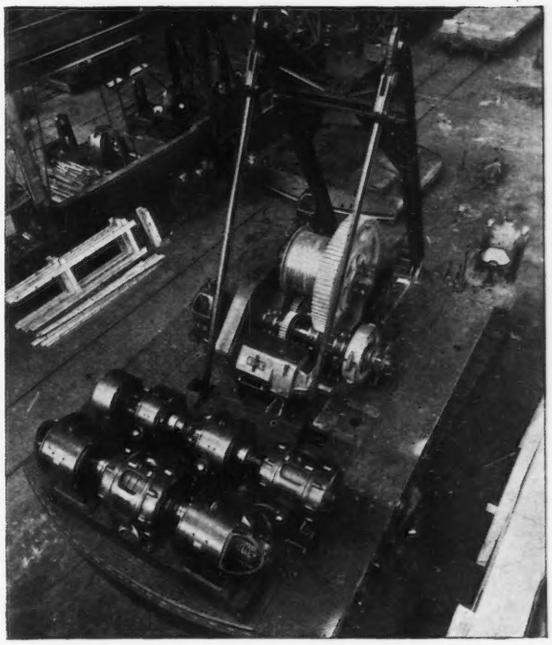
[3] Gross, John: *Op. cit.*

[4] Gross, John: *Op. cit.*

High-Speed Electric Shovel Compact in Design

This type of excavator finds increasing use

H. R. Johnson
Westinghouse Electric & Manufacturing Company
Milwaukee, Wis.



COMPACTNESS and ingenuity mark the arrangement of equipment mounted on floor of revolving structure of electric shovel, seen here partly assembled in the shop. At the rear is the motor-generator set which operates the hoist motor, the hoist itself being on the forward half of the platform. In front of this set is a second set comprising the driving motor, swing and crowd generators, and a blower

TODAY the rapid removal of waste material over low-grade ore deposits and the excavation of the low-grade ore itself at a minimum cost have created an increased demand for the high-speed electric shovel. The steam and early electric shovels were notably heavy, slow-moving units. They were built largely of steel castings, shafting, and gearing of rather low quality where weight was largely used as a measure of strength. From this arose the idea that the value of a shovel was directly proportional to its weight.

Use of high-grade alloy steels throughout has greatly increased the strength of shovels, which weigh approximately the same as the older types. This increase has made possible the application of much more electric power with higher operating speeds than was formerly thought possible. The older rheostatic-controlled electrical equipment has been replaced by the more efficient variable-voltage field-control system. This consists primarily of a motor driven by its own individual generator, which generates power as required for the connected motor, the armatures of the generator and its motor being permanently connected together. The generator usually has a differential series field and two shunt fields. One of these shunt fields is separately excited from a constant-voltage exciter. The magnitude and the direction of the excitation of this field determine the speed and direction of rotation of the motor. The other shunt field is normally self-excited from its own armature circuit. This produces higher operating motor speeds than are otherwise possible.

Three such units, consisting of a generator and a motor, are used to drive the hoist, crowd, and swing motions. The shovel dipper has three definite motions: that of being pushed into the bank of material being removed, termed the "crowd"; that of being pulled up through the bank, termed the "hoist"; and that of being moved from the point of excavation to the point where the dipper is unloaded, termed the "swing." The generators are usually grouped with an a.c. motor to form a motor-generator set. At times when a single set becomes too long it is divided into two sets, each being driven by its own a.c. motor.

For example, consideration of a 4-cu.yd. shovel indicates the compactness and ingenuity of modern design. The lower structure is a heavy steel casting to which the corduroy frames are bolted. The crawler consists of multiple sets of twin rollers transmitting the shovel weight to the corduroy shoes. On top of the center casting is mounted the external tooth swing gear and the line roller circle, the latter supporting the weight of the cab with all its equipment. The propelling mechanism, consisting of gearing, shafting, clutches, and brakes, is located on the under side of the main center casting and is controlled electrically from the operator's station. The equipment mounted on the upper revolving structure is arranged to have ample working room and still avoid congestion. At the rear is mounted the hoist motor-generator set consisting of two 95-kw. generators driven by a 200-hp. a.c. motor. These two generators operate as a single unit to produce 190 kw., which is supplied to the 187½-hp. motor directly geared to the hoist drum.

The second motor-generator set consists of one 125-hp. a.c. motor driving a 60-kw. swing generator, a 30-kw. crowd generator, and a blower. The crowd generator energizes the crowd motor mounted on the boom, which is geared to a rack on the dipper sticks transmitting the pushing or crowding motion.

The swing generator supplies power to the two 30-hp. vertical swing motors mounted on the main revolving frame. Each motor is of the vertical ball-bearing type connected to and mounted as a part of the reduction gear unit. The gear unit is totally inclosed and runs in oil. The pinion which engages the swing gear on the main center casting is mounted on the output shaft, which projects below the frame. These motors operate as a single unit. Use of vertical motors conserves space and eliminates bevel gears which were used when the conventional horizontal motor was employed.

A central blowing system furnishes forced-air circulation for all motors, the air being carried to the motors by ducts under the floor.

The operator in the cab, through the master switches, has complete control of the shovel, as from his station he starts the motor-generator sets and propelling mechanism, as well as the hoist, crowd, and swing motions.

New Ore Transport Methods Serve

This Mesabi Range iron mine now uses tractor trucks and conveyors

USE of trucks and conveyors in combination is now a feature of operations in the St. Paul open-pit iron mine of the Republic Steel Corporation at Keewatin, Minn., on the Mesabi Range, for transporting the ore from the shovels to a bin on the surface outside the pit, either for direct shipment or for washing prior to shipment. Crawling tractor trucks equipped with 13-cu.yd. two-way-dump trailers are loaded by two 1¼-cu.yd. gasoline-engine-driven shovels and haul the ore to a hopper below the pit floor, which delivers it to the lower end of the belt-conveyor system. For dumping, each trailer is equipped with an hydraulic hoist mounted on its main frame.

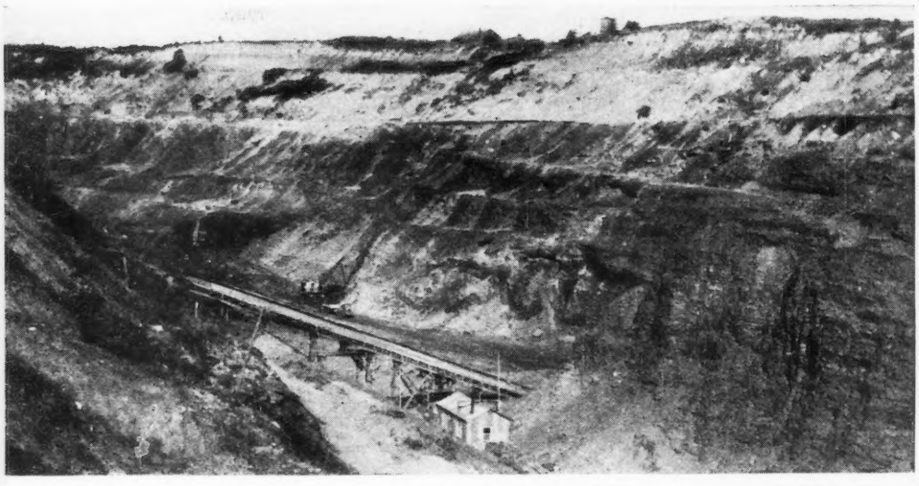
This innovation was planned following an estimate by engineers in 1935 which showed that it would be possible to operate the mine for only one more year by steam-locomotive haulage. This was due to the physical condition of the pit, which had been mined to a depth of 225 ft. since the mine was opened in 1905, and also to the fact that a considerable amount of the ore remaining was in the benches carrying the tracks used to haul the ore out of the pit. The distance from the point of loading to the mine yards where the ore cars were turned over to the railroad was a mile and a half, with a uniform grade of 3 per cent.

The engineers' study indicated three possible methods for removing the ore remaining to the surface: One was to sink a shaft, drive a long rock drift, install a hoist, and erect a hoist building. The second was to install an incline along the pit bank, with a shaft at the bottom of the incline, of sufficient depth to allow the loading of skips. This also necessitated the erection of an engine house and the installation of a hoist. The third possible method, that of employing a conveyor system and trucks, was adopted, not only because its first cost was less but because it showed a decreased operating charge.

The trucks dump the ore directly onto a grizzly, the fines going to the pocket. Oversize goes to a crusher, from which the crushed product drops into the same pocket as the fines. From the pocket the ore is fed onto the conveyor by a feeder with 9-ft. centers and 6-in. pitch and capable of handling 250 tons or iron ore per hour at a speed of 25 ft. per minute. The conveyor transports the ore from this pocket at the bottom of the pit to a steel bin on the surface. From this bin it is loaded into railroad cars if it is intended to be shipped by rail or water, or into dump cars if it is to be washed.

The conveyor system has a length of slightly less than 900 ft. and is constructed in three sections, having 284-ft. centers. Each conveyor operates on an incline of 19 deg. 10 min. from the horizontal, and at a speed of

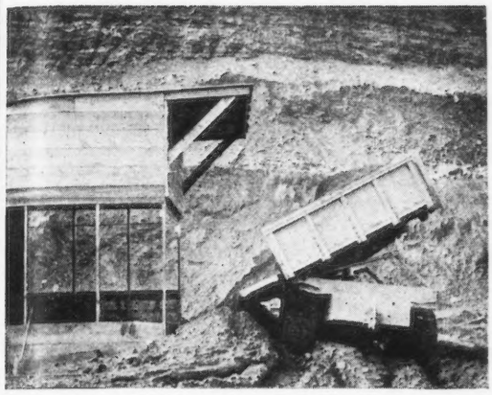
THE ST. PAUL PIT looking approximately lengthwise along it. The conveyor line can be seen rising out of the pit and beyond it in the distance two shovels at work

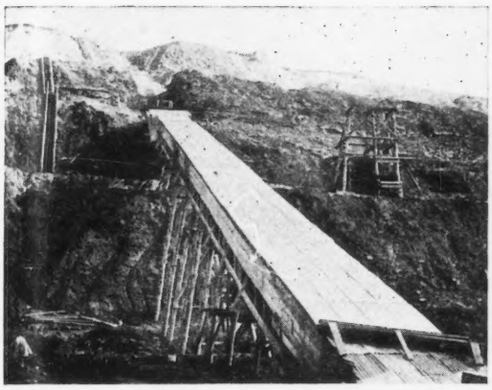


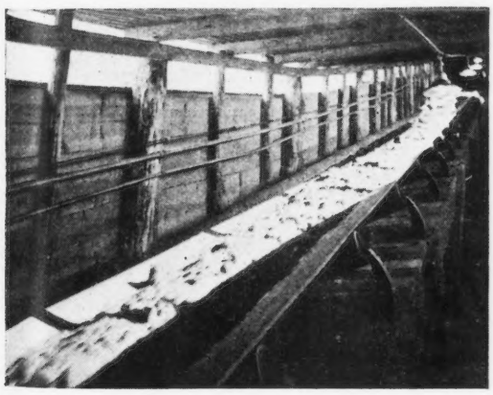
TRAILER DUMP TRUCK (left) ready for a load in the St. Paul pit. The gasoline-driven shovel digging in the bank to loosen up the ore is one of two such units on this job

THE LOADING OPERATION (right) down in the pit, seen from a distant point on the edge of the open cut

in St. Paul Open Pit



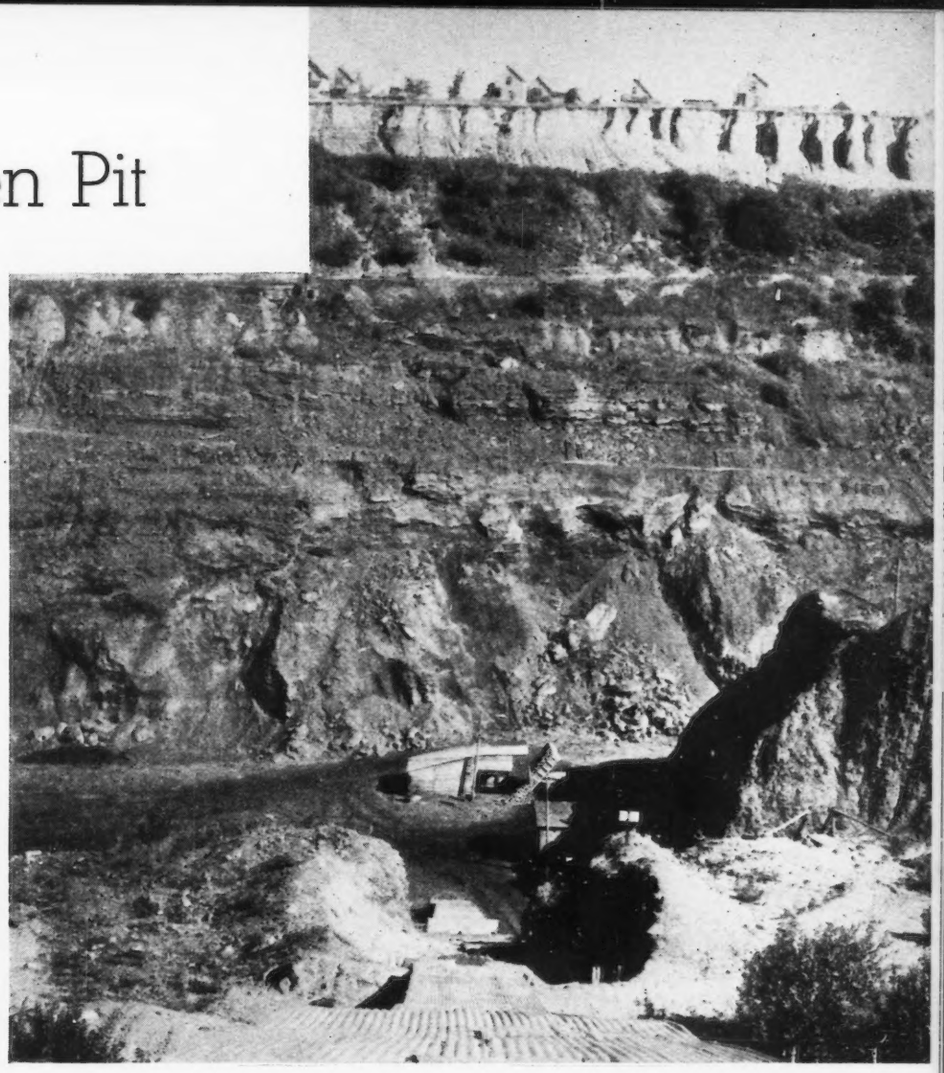




DUMPING (top) a load of iron ore into the hopper in the pit floor, from which it is fed onto the lower end of the 900-ft. three-section belt conveyor system for transport to the surface

THE CONVEYOR INSTALLATION, housed, on its way out of the pit (middle, above). Grade and location are such that, starting underground beneath the hopper, the line of three conveyors emerges to pass over this trestle, then goes underground again to pass beneath the edge of the pit and to emerge again beyond it on the surface, finally arriving at the car-loading bin, shown in the accompanying photograph

INSIDE THE HOUSING (bottom) one of the three conveyors is seen on its way up to the loading bin with its stream of ore



LOOKING DOWN the housed conveyor line from a point a short distance below the edge of the pit. Beyond the end of the housing on the bottom a truck can be seen dumping into the hopper which supplies the conveyor. Another picture shows this operation close up

350 ft. per minute. It is intended to handle iron ore with lumps of a maximum size of 4½ in.

Each of the three belts is 578 ft. long, of 6-ply, 32-oz. construction, and 30 in. wide. In all there are 192 carrier troughs, each having three 5-in. diameter pulleys. The pulleys are removable. They are made of tubular steel and are equipped with roller bearings.

The three head shafts are driven by gear motors through a chain using a 12-tooth and a 37-tooth sprocket. The head shaft drives a cast-iron rubber-lagged pulley 36 in. in diameter and 32 in. wide. Gear motors are rated at 40 hp. at 2,200 volts. The empty belt requires 4.2 hp. to drive it and the loaded belt 36.3 hp.

The conveyor system is controlled by pushbutton. The lowest or first belt in the system is started first, then the second and the third successively, as the ribbon of ore advances on its way to the 120-ton steel bin on the surface. A walk-way is provided inside the housing for the entire length of the belt to permit inspection and oiling.

AT THE TOP of the conveyor system the ore drops into this steel bin, from which it is loaded into cars. These are railroad gondolas, as shown, if it is to be shipped directly to the docks; otherwise into dump cars for transfer to the washing plant

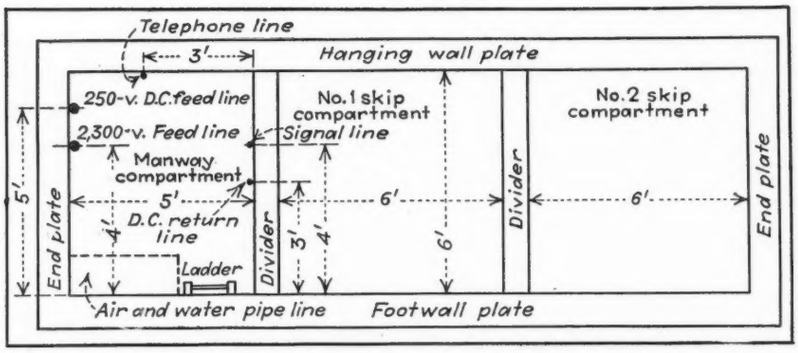


Fig. 1 . . . THE POWER CABLE is carried down the Burra Burra shaft in the manway compartment, as shown in this horizontal section

Power Distribution Underground

At Burra Burra Mine

System designed to give efficiency, economy and safety

Lamar Weaver
Assistant Mine Superintendent
Tennessee Copper Company
Ducktown, Tenn.

MORE than 57 per cent of the ore at present produced by the Tennessee Copper Company in the Ducktown district, Tennessee, comes from the Burra Burra mine, its principal operation for over thirty years. The workings extend for 2,800 ft. along the strike of the lenticular, steeply dipping deposit and have now attained a depth of 2,400 ft.

Two shafts, the Burra Burra and McPherson, serve the mine. The former is 1,600 ft. deep and inclined at 74 deg. from the horizontal. McPherson shaft is vertical and 2,400 ft. deep. Each shaft has three compartments, two for haulage and one for ladderway and service lines. The relative location of the ladder and service lines and the general dimensions of shaft openings are illustrated by Fig. 1. The ladder compartments of the two shafts are practically of the same dimensions and are similarly equipped, having water and air pipe, pump discharge columns, telephone and signal lines, and the two power lines.

Electric power is supplied by the Tennessee Electric Power Company from its substation near the McPherson power house. This substation has been modernized recently to insure better service. The equipment includes two separate supply transmission lines, a spare transformer, and the necessary oil circuit breakers and automatic switches.

Electric energy for the total mine power load is delivered to the busbars in the McPherson power house at 2,300 volts, as 60-cycle alternating current. This power is distributed from the busbars to the underground feeders, No. 1 feeder going to McPherson shaft and No. 2 to the Burra Burra power house through a switchboard such as is shown in an accompanying photograph. From the busbars in each case the current travels through disconnect switches and metering transformers to an inclosed oil switch or circuit breaker. The switch control lever, with voltmeters, ampere meters, and kilowatt-hour meters, is on the front of the sectionalized slate switchboard. The panels are 20 in. wide and 7½ ft. high. Provision of disconnect switches between the bus and circuit breaker is a valuable addition in case of trouble with the latter, as it permits safe repair in the event of failure with minimum delay to other feeder lines.

Some of the desirable features of the arrangement of the equipment behind the switchboard are: ample headroom under the busbars, ample walkway and working space between the back of the switchboard and the oil switch, adequate working space behind the oil switch, and the placing of power lines and control lever rods through and under the floor. This arrangement makes it possible to make repairs efficiently, and in safety, on any part of the equipment behind the switchboard.

The connected load for No. 1 feeder totals 459 hp., consisting of 219 hp. for pump motors, 125 hp. for scraper motors, 45 hp. for ventilating fan motors, 40 hp. for an underground hoist motor, and 30 hp. for station car spotter motors.

For No. 2 feeder the connected load includes 505 hp. for pump motors, 15 hp. for one ventilating fan motor, and 10 hp. for a station car spotter motor, a total of 530 hp.

The combined alternating current load is 989 hp., consisting of 724 hp. for pumps, 125 hp. for scrapers, 60 hp. for ventilating fans, 40 hp. for underground sinking hoist, and 40 hp. for car spotters.

Direct current at 275 volts is used for the underground trolley haulage locomotives, a few electric lights, and occasionally for a small or temporary motor job. The direct-current generating equipment has been limited to the demand set forth in the foregoing. Alternating current is the more desirable power for our work.

Alternating current is transmitted at 2,300 volts through the shaft feeders No. 1 and No. 2 along conductors of sufficient current-carrying capacity to supply the present and expected power requirements. The electrical department recommends the type of insulation, conductor-covering protec-

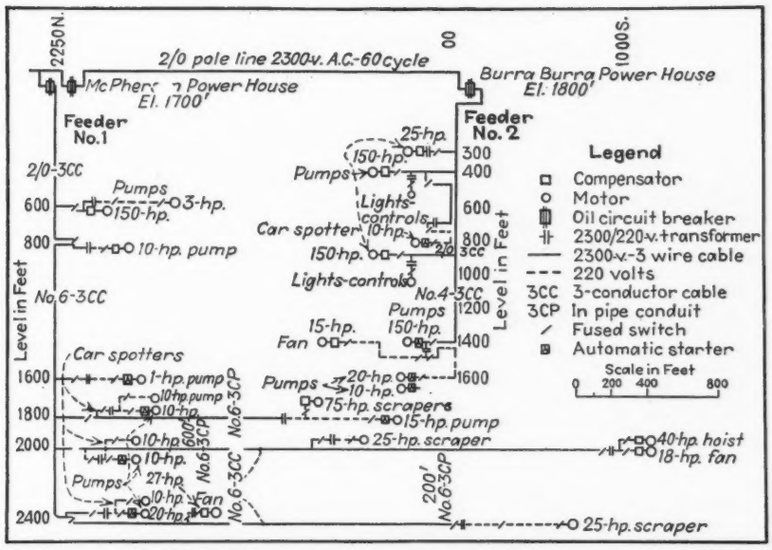


Fig. 2 . . . DISTRIBUTION of alternating current through Burra Burra and McPherson shafts is shown diagrammatically on this elevation

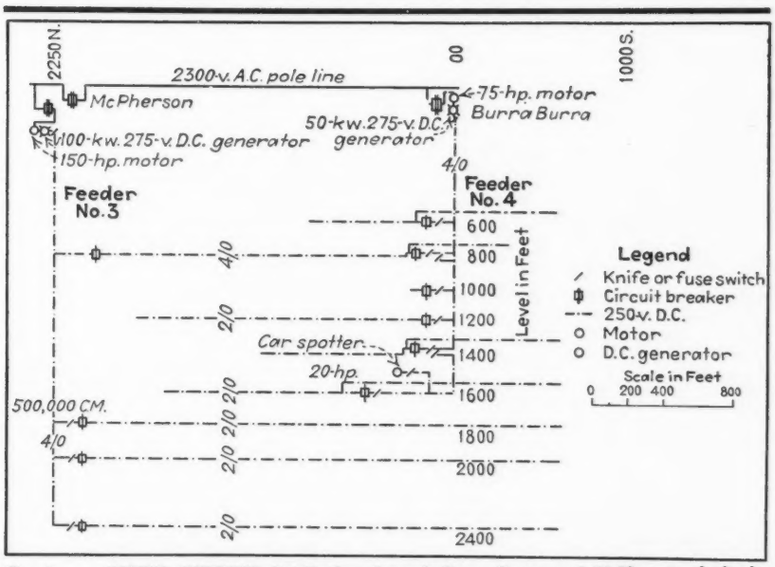


Fig. 3 . . . DIRECT CURRENT distribution through Burra Burra and McPherson shafts is effected by means of feeders Nos. 3 and 4, respectively, as shown here

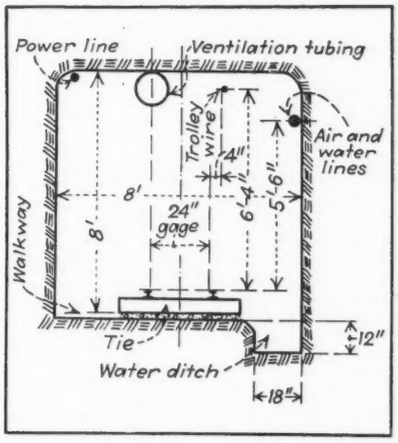


Fig. 4 . . . HAULAGE DRIFT in cross section showing the location of the trolley wire and of the 2300-volt branch connecting line on the 8th level, which is provided to take power from either feeder

tion, grounding methods, and size of conductors. The value of continuous service over the a.c. and d.c. feeders is recognized and extreme care is exercised at time of installation to assist good maintenance.

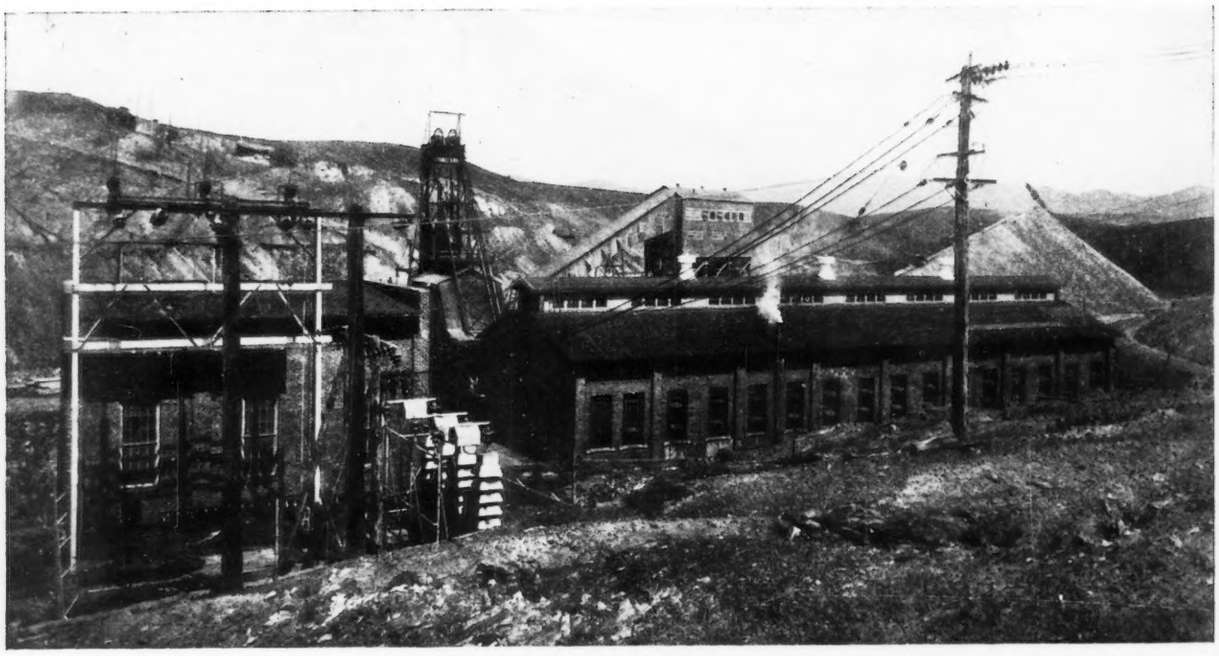
Both shafts have drainage water sufficiently acid to attack ferrous metals so seriously that pipe conduits have been replaced with a lead-covered cable. The lead covering successfully seals the water from the conductor insulation. Feeder No. 1 to the 800-ft. level, No. 2 to the 1,400, and No. 3 to the 1,800 level have each a spiral steel covering and over this steel a protective jute and asphalt covering. This was thought to be of advantage at the time of installation, as the steel would carry the cable weight on fewer supports and would give protection to the lead sheath in the event of being struck accidentally by any object. Experience has shown that it is necessary to clean and paint the surfaces exposed to water drips, around supporting clamps and level floors, to save this covering of asphalt, jute, and steel.

Extensions of feeders No. 1, 2, 3, 4 and most of the level branch lines (since 1932) have been of lead-covered cable with an asphalt jute-wrapped protective cover. The advantages of this cable over the steel-covered cable are that there is less weight to handle, the purchase cost is less, and it is much easier to cut for a connection or splice. The disadvantages are that it has less protection from impact and requires more supports. In installing long lengths of either cable in a vertical shaft it is advisable to use a steel pilot cable to support the weight of the cable until permanent supports are in place. These supports are of two-piece, 4x4-in. walnut wood blocks bored for clamping around the cable with bolts. A $\frac{1}{8}$-in. rubber gasket is used between the wood clamp and the cable to increase the friction and to cushion the effect of the wood block. The clamp is in turn supported as may be convenient by the shaft members. Good practice in spacing supports for lead cable in a vertical shaft is to place them 10 to 15 ft. apart; for steel-covered cable, about 25 ft. apart.

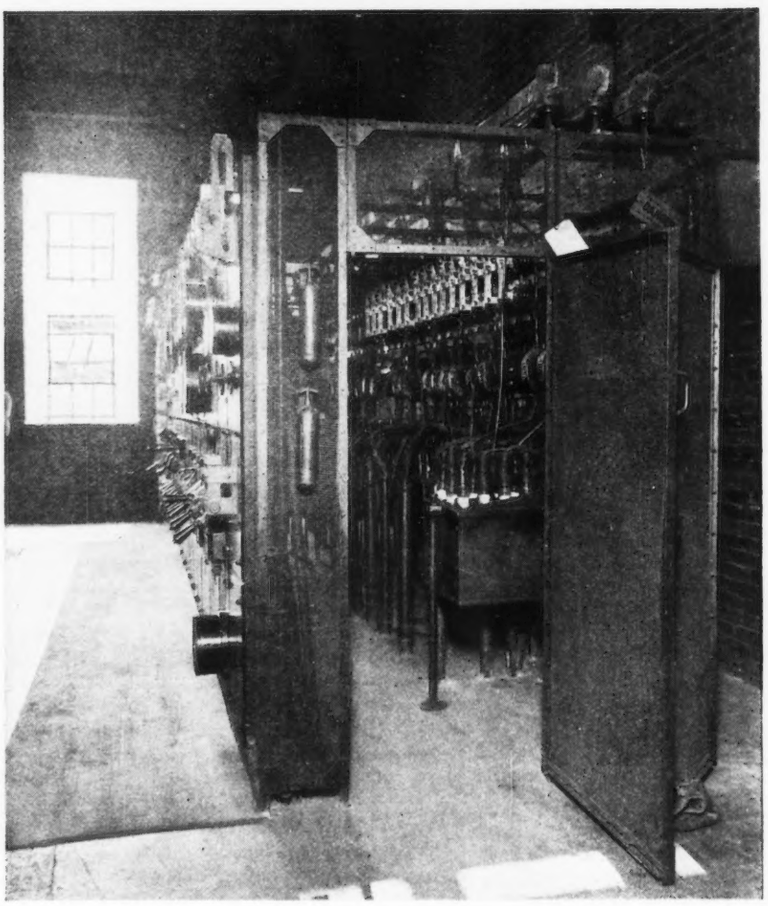
The inside construction of the cable up to the lead cover is specified on purchases as follows: "3-conductor stranded No. 6 A. W. G. cable, each conductor insulated with 8/64 in. 30 per cent rubber compound, conductors stranded together with fillers, over the assembled conductors a rubber-filled tape and incased in 5/64-in. lead sheath with jute over all finish for 3,000- to 4,000-volt service." The larger cable (2/0) of feeder No. 1 has a 6/64-in. lead sheath and over the lead one layer of jute, then two flat steel tapes of 0.02-in. thickness with jute covering over them. The trade name for this cable is "Parkway."

Rubber is preferred to cambric as the insulating material because of its greater resistance to moisture. The asphalt painting is also water- and acid-resisting.

Feeder No. 1 of 2/0-size conductor to the 800-ft. level is brought out on the level to fused disconnect switches and a No. 6 conductor is returned to the shaft and extends down the McPherson shaft at this size to the 2,400-ft. level. The branch-line connection to the feeder on the 600-ft. level was made by cutting and removing a section of the steel and lead covering of the feeder for a length of about 18 in. The insulation was then cut around the individual wires



AT McPHERSON SHAFT. At the left is the Tennessee Electric Power Company's substation from which all power required by the Tennessee Copper Company is delivered at 2,300 volts to the latter company's power house at the right



THE SWITCHBOARD in the power house at McPherson shaft. Ample head room is provided under the busbars, as well as ample space back of the board for working

and the wires were thoroughly cleaned for electrical connection to the lead-covered branch of the feeder cable wires. These connections are twisted, soldered, and the individual wires insulated with rubber, linen, and friction tapes, and a coat of paint. The final and important job is to cover this connection completely with sheet lead 9/64 in. thick, burning all seams to seal out moisture and complete the grounding connection. This burning is necessarily slow to prevent overheating of the rubber insulation of the cables, but with ordinary precautions and care in the shaping of the lead a good job can be obtained.

The branch connection to the feeder is made about 2 ft. above the level back to be as well protected as possible from the usual level activities of the workmen around the shaft. The branch cable is extended along the side of the level opening, as near the roof as is convenient for clamping it securely, to a place suitable for the fused disconnect switches. The reason for these fuses is primarily to protect the shaft feeder cable, and the disconnects permit work on the branch line where men would be tempted to take the chance of working a hot line rather than delay workmen on other levels.

In general, shaft feeder lines were extended in sections of one or two levels as power was needed on lower levels; and in such cases it was more desirable to run the cable from disconnect switches located in a dry and convenient place on the level, over to the shaft and down, than to make a splice and a branch connection in the wet shaft.

The advantages secured by the additional cable, the extra switches, and extra support clamps that are required to present a good appearance are well worth the cost. This break

in the feeder line is of advantage in case of feeder trouble. It eliminates a splice in the shaft, which though carefully made would be the most likely place for trouble; and in case of old cable renewals, a shorter section can be put in quickly to restore power service.

In practice every effort is made to avoid branch lines in the shaft. We prefer rather to connect the branch lines to the feeder on the level where the power is needed, as on the 600-ft. level McPherson shaft.

Details of Electric Installation

The voltage on branch lines is 2,300 volts. With the exception of the four 150-hp. pump motors, the motors are operated on 220 volts. The 220-volt motor lines are as short as can reasonably be planned.

Transformers are placed near the motor except where the hoist for a portable loading scraper is to be supplied, when the maximum is about 1,200 ft. for the 25-hp. load. The practice when following a development drift, where a scraper loader is used for loading the muck, is to advance the 2,300-volt cable in lengths of 1,000 ft., moving the transformers up to about 200 ft. of the drift heading.

All 2,300-volt conductors are inclosed in a metal covering which is grounded for safety. The 220-volt conductors consist of rubber-insulated wire hung in the open on porcelain rings or wooden hangers. A rubber-covered cable is a convenience about a portable machine.

Feeder No. 2 in Burra Burra shaft was originally planned for the three 150-hp. 2,300-volt pump motors. The pumps are connected in line for lifting the mine water in stages from the 14th level sump through the 14th, 9th and 4th level pumps to the surface. The 9th and 4th level pumps are started and stopped automatically. Starters are of the oil-immersed type. One of the control features of the electric starting is a switch that is held closed by a flow of current passing through it. The starting of the 14th level pump motor closes the switch for the 9th level pump, and with the two running, the switch closes for starting the 4th level pump. The switch is an adjustable solenoid actuated by a single-phase off-the-feeder line. Additional loads on this feeder below the 4th level will affect the operation of this protective feature.

Underground A.C. Motors and Starting Equipment—The 150-hp. motor on 600-ft. level is a pipe-ventilated squirrel-cage unit (speed of 1,700 r.p.m.). This motor was chosen because of the excess dampness of the location. The starter is manually operated and is of the reduced-voltage type with a pushbutton stop. The motor is automatically stopped by a pressure valve and a check valve electric switch. It is hand-started and left running until the sump is pumped empty or the operator returns. The 150-hp. motors of the 4th, 9th, and 14th levels of the Burra Burra mine are of the open-type, 1,700-r.p.m., 2,300-volt induction class. The 4th and 9th level starters are of the fully automatic, E. C. & M., oil-immersed, reduced-voltage type. The 14th level starter is of the hand-operated, reduced-voltage type.

Other pump motors are of the squirrel-cage across-the-line type, operating at 3,500 r.p.m. on 220 volts. Starters are automatic and of the magnetic across-the-line type, started and stopped by a single-pole G.E. float switch located over the water tank. The motors are protected from starting, in case the pump is not primed, by a pressure switch set to keep the starting circuit open unless there is water in the discharge line.

Cross-the-Line Motor Favored

In general, motors of the low-starting-current and normal-starting-torque type are preferred for across-the-line starting. The cross-the-line type of induction motor is favored because it is simple, easy to maintain, low in price, and otherwise satisfactory for our mine service.

Direct-Current Equipment — Two generators furnish power for trolley locomotives (as illustrated by Fig. 3) over feeder line No. 3 in McPherson shaft and No. 4 in Burra Burra shaft. On the 8th level there is a 4/0 branch connecting line arranged to take power from either feeder, or in the event that one of the generators is down, this line is used as a branch feeder for both shafts, limited of course to the generating and transmission capacity. This permits operation of a few of the important places in case of emergency. The 8th level branch also has a 2/0 trolley line 3,000 ft. long out the McPherson-Eureka-Isabella haulage drift. Wire of figure 8 section is used on all levels, suspended over the rail from the roof of the haulageway by hangers spaced 2 to 15 ft. apart. (Fig. 4.)

The McPherson 100-kw. 275-volt, loading-and-unloading-type generator is driven by a 150-hp. 2,300-volt synchronous motor through McPherson switchboard panel 13. Panel 14 has a direct current breaker and a voltmeter and ampere meter for indication of current supplied to feeder No. 3. This conductor is 500,000 circ.mils in size to the 1,800-ft. level, a length of about 1,900 ft. from the switchboard shown in the photograph.

The construction of the feeder cable is similar to the Parkway as described for the a. c. cable: rubber insulation, lead sheath, and flat steel covering. The cable is brought out on the 1,800-ft. level to a disconnect switch and is extended back to the shaft and down to the 2,400-ft. level in a rubber-insulated, lead-covered and jute-wrapped cable. Branch connections in the shaft are made in the manner described for the a. c. branch connections. Originally, connections were made in a junction box at levels, but this has proved unsatisfactory because of water accumulating in the boxes by leakage or condensation sufficient to form a conductor for charging the outside of the metal box and adjacent wet timbers.

All branch lines leaving the feeder have an inclosed knife switch and a circuit breaker. This circuit breaker is maintained for safety, because in an emergency the circuit breaker can be opened by direct grounding of the trolley wire to the rail or to the drift back, and serves regularly as a protection against overloading the motor and grounding of the motor or trolley wire. Open direct-current lines are dangerous and are prohibited where groups of men congregate and at active working places such as: a shaft loading station, a loading chute, in loading grizzlies, or in hand-loading places and dynamite magazines. Where the magazine is near the main haulage track, the trolley wire is guarded with wood boards. Power is conducted to motors at loading places and shaft station by a motor cable reel. The safety and control devices for the locomotives are: good lights on front and rear, alarm bell, brakes, sand feeder, cable reel, cable reel fused switch, and a trolley line switch. All motormen receive instruction in the care and maintenance of their motors and make minor repairs and adjustments when needed. Only experienced men are permitted to use the locomotives.

Importance of Uniform Voltage

The maintenance of uniform voltage is important with the locomotives in starting and pulling loads with increasing difficulties near the extremities of the lines. Power loss with unusual heating of the conductors and motor wiring is the first evidence of serious voltage loss. Later the insulation becomes damaged and shorts occur, causing delay for repairs and increasing repair costs. Short circuits sometimes burn holes in the controller housing and burn out coils and grounds to the frame, so that the motorman may get a severe shock. Operating voltage is planned for 250 volts, with a maximum drop of 15 per cent allowable. The electricians are interested in maintaining the voltage and usually detect trouble of this kind immediately. Most of the trouble is generally found in the negative or return lines.

The d.c. return is the 40-lb. haulage rails, bonded in the approved method. Rail bonds used are 2/0 size stranded copper wire with the pin wedge fastening through a hole in the rail. A 4/0, or larger, conductor connects the rails to the shaft return line, and for the McPherson shaft this wire is a 500,000 circ.mil. stranded wire. The return line through the shaft should always be as large as the feeder to prevent damage to pipe lines by electrolysis and damage from arching.

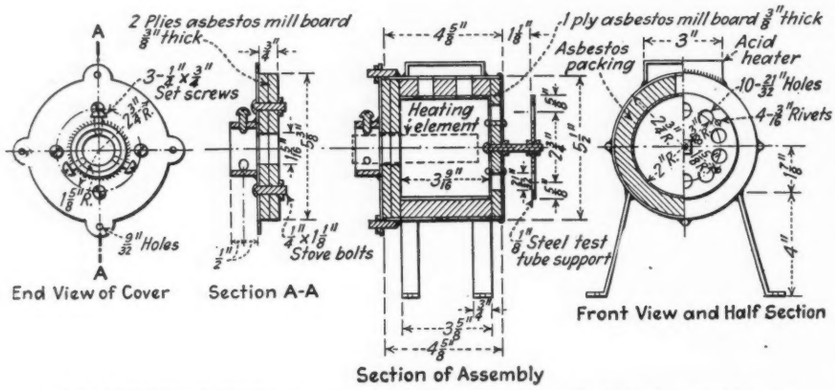
▼ ▼ ▼

Quicksilver Assay Retort Gives Good Results

THE small electric furnace for assaying quicksilver developed by T. L. O'Connor, of the Mirabel Quicksilver Company, and explained in detail in the accompanying line cut, is used with considerable success at the company's property near Middletown, Calif. Although the idea is not new, the improvements incorporated in the design of this unit are apparent when contrasted with the furnaces currently used.

with a standard potassium thiocyanate solution.

Absolute accuracy is not attained by the described method, as a little more condensation loss occurs than with the Bureau of Mines procedure. However, this is offset to a great extent by standardizing, and as most mercury samples are not representative samples anyway, the method serves well for run-of-mine samples, head samples, and slag. In fact, results check closely

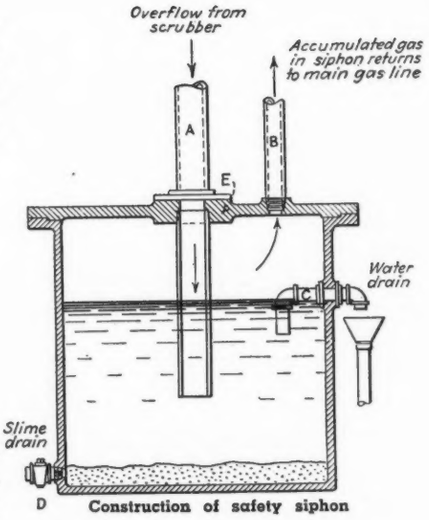


THIS ELECTRIC FURNACE for assaying quicksilver ore will hold ten 5/8x6-in. retempered test tubes

The company employs a variation of the United States Bureau of Mines method of mercury determination (United States Bureau of Mines Bulletin 335), which explained briefly is as follows: The ore is mixed with calcium oxide, iron filings, and cupric oxide and placed in a test tube, with a cover of Ottawa sand. Next, the tube is set in the furnace just far enough to have the charge in contact with the heat, the protruding part of the tube serving as a condenser for the mercury. After a period of from 15 to 18 min., the tube is removed, and the lower end containing the spent charge is broken off by a stream of water. Condensed mercury is dissolved by pouring hot concentrated nitric acid into the tube. The solution is allowed to cool and then oxidized by potassium permanganate. Excess permanganate is bleached by a drop or two of hydrogen peroxide and a solution of ferric sulphate added as an indicator. The solution is then titrated to a red color with those of custom assayers. The technique is much simpler than conventional practice, and as high as 50 to 60 determinations, including the weighing of samples, have been made during the course of a single afternoon.

Construction details of the furnace are indicated in a self-explanatory way in the accompanying line cut, referred to previously. Experience has shown, however, that the 600-watt element is too hot, and that better operating conditions can be obtained by using a 500 or 550-watt element. Since only 600-watt elements are carried in stock by all dealers, installation of a short length of resistance wire in series with the furnace will effectively remedy this defect.

The furnace proper holds ten 5/8x6-in. common retempered test tubes. Nitric acid is heated on top of the furnace, which can be made at the mine from scrap material by a sheet metal worker or blacksmith.



Construction of safety siphon

This Siphon Kills Producer-Gas Fumes

AT A REMOTELY SITUATED lead-silver mine in northern Mexico, electric power for mine and mill operations is generated in a 175-hp. gas-producer plant, consisting of the gas producer proper and two 75-hp. engines direct-connected to generators. All machinery and appurtenant equipment are housed in one building to make possible one-man operation, and ventilation of the interior of the steel-frame building is accomplished by simply opening the main door and windows. This method afforded adequate ventilation under normal weather conditions, and no complaints were received from the operator until severe winter weather and storms required most of openings in the building to be shut.

It was found that after a few hours of operation the condition of the air was such as to incommode the man in charge of the plant. First the difficulty was attributed to leaks in the pipe system, but the problem became more puzzling when a thorough inspection revealed no such defect. Finally, it was discovered that the offensive fumes were generated in and escaped from the open siphon handling the wash water drained from the scrubber.

Howard Beck, master mechanic, solved the problem successfully by installing the closed siphon explained in the accompanying sketch. Gas or fumes present in the tank are directed through pipe *B* to the main gas line, and the water drain contains a gooseneck or pipe *C* as an additional safety measure. No escape is possible through this channel. The cost of the new siphon was nominal, as the original cast-iron tank and scrap material were used in its construction. Lid *E* need not be bolted to the flange of the tank

PERSONAL ITEMS

Russell Cornell, mining engineer, of New York City, is on a trip to South America.

A. E. Hepburn, consulting mining engineer, is engaged in mine examination at Randsburg, Calif.

W. R. Lindsay has been appointed resident manager of Granby Consolidated at Copper Mountain, B. C.

B. C. Austin, consulting engineer, has moved his office from the Mills Building to 417 Balfour Building, San Francisco.

Clyde B. White is now managing director of Silver Crescent, Inc., a silver-lead prospect between Wallace and Kellogg, Idaho.

Anton Granningsaeter, consulting metallurgist for Falconbridge Nickel Mines, has returned to New York from Norway.

William Sharp, field engineer for the Tonopah Mining Company of Nevada, has been examining mine properties in Oregon.

James MacNaughton, president of Calumet & Hecla Consolidated Copper Corporation, was in New York City recently for a brief visit.

A. Brown has relinquished the management of Lady Shenton Gold Mine, Menzies, W. A., and has been succeeded by **J. O. McArdell.**

C. E. Tonry, formerly of Telluride and Cripple Creek, Colo., is now at Silver Peak, Nev., where he is superintendent for Desert Silver, Inc.

Frederick G. Clapp has left Iran to spend some time with the geologists of the Inland Exploration Company now in the field in Afghanistan.

A. H. Telfer has been appointed Under-Secretary for Mines in Western Australia in succession to **M. J. Calanchini,** who retired in June.

Russell J. Spry, mining and metallurgical engineer, has moved from Seattle to Vancouver, B. C., where his address is 1379 West 46th Ave.

G. F. Cooper has been made president and a director of the Potash Company of America. The mine and plant of this company are at Carlsbad, N. M.

Robert Welch is now with the engineering department of the Anaconda Copper Mining Company, at Butte, Mont. His address is P. O. Box 712, Butte.

J. P. Dick has resigned as manager of Gillies Lake-Porcupine Gold Mines, Ltd., to become mill superintendent for Moneta Porcupine Mines, Ltd., at Timmins, Ont.

John G. Clark, managing director of the Gold, Silver & Tungsten, Inc., has been at his company's Nightingale scheelite mine in Nevada from his office at Boulder, Colo.

A. D. Marriott, engineer for The Dorr Company, Inc., arrived in Tokyo on Nov. 13 on a tour of metallurgical plants in Japan, Manchukuo, the Philippines, and Australia.

C. C. Downie, metallurgist, of Glasgow, Scotland, sailed for home from New York on Nov. 26, after spending several weeks visiting metallurgical works in the United States.

George H. Cunningham, electrolytic zinc engineer, who recently returned from a professional visit to Peru, left for Europe in November for several months on business.

Robert Linton, consulting engineer, of Los Angeles, received the honorary degree of doctor of science from Washington and Jefferson College on Founders' Day, Oct. 30.

H. DeW. Smith, of the board of Newmont Mining Corporation, is on his way to Africa to visit the O'Okiep property of the corporation, in Namaqualand, South Africa.

H. T. Curtis, consulting engineer, sailed from London recently for Viseu, Portugal, where he will be engaged for some time at the Mina da Bodiosa, a wolfram property.

George H. Wigton, formerly metallurgist for Chief Consolidated Mining Company at Eureka, Utah, is now mill superintendent for the San Juan Metals Corporation at Ouray, Colo.

John S. Stewart has returned from London for a visit over the holidays and is making his temporary headquarters at the offices of the American Metal Company at 61 Broadway, New York.

Ellis Davies visited Western Australia in October to be present at the official opening of the Big Bell Mine's plant, near Cue. His firm, Charles Ruwolt Pty., Ltd., supplied most of the equipment.

Frank Eichelberger, president of the Sunshine Consolidated and manager of the Callahan Zinc-Lead Company, is now in New York on mining business following a trip to Arizona and Colorado.

Fred E. Hall recently left the Pickle Crow Gold Mines, Ltd., at Pickle Crow, Ontario, to take over the position of mill superintendent at the Gold Eagle Gold Mines, Ltd., plant at McKenzie Island, Ontario.

F. C. Bowman, mining and metallurgical engineer, has returned to Denver, Colo., after the completion of construction of a cyanide plant for the Gilt Edge Mines, Inc., near Deadwood, S. D.

John R. Reigart, former manager of the Iron Mountain Lead & Zinc Company, has accepted a position in the ore purchasing and shipping department of the Eagle-Picher Mining & Smelting Company.

B. R. Berthelson, mining engineer, who recently joined the staff of Empire Star Mines Company, Ltd., has been appointed superintendent of the company's Zeibright unit, near Emigrant Gap, Calif.

Don Carlos Billick, formerly manager of Spring Hill Gold Mines, Inc., at Grass Valley, Calif., has been placed in charge of the Rawhide mine, near Towle, Calif., operated by Canyon Mines Corporation.

G. R. Fisher, underground manager, and **M. Mawby,** mill superintendent, of the Zinc Corporation, Ltd., Broken Hill, Australia, are in North America, and will visit the mines and mills of the more important producers.

L. T. Gaines, formerly mill foreman with the Carlyle Mining Company, Twenty Nine Palms, Calif., has accepted a position with the Cuban Mining Company as mill shift foreman. His address is Cristo, Cuba.

W. B. Donaghue, formerly in charge of the cyanidation plant of Bayonne Consolidated Gold Mines, Ltd., at Tye, B. C., has been appointed mill superintendent for Dentonia Mines, Ltd., at Ymir, B. C.

Jay A. Carpenter, director of the Mackay School of Mines, Reno, Nev., represented his State at hearings on Boulder Dam in Washington, D. C., late in November. He also visited in New York before returning to Reno.

D. N. Vedensky, chief metallurgist for the Pan-American Engineering Company, has returned to his headquarters at Berkeley, Calif., after a protracted trip to Alaska, where he visited numerous dredging operations.

Harold B. Ewoldt has resigned as mine superintendent of Gregory-Bates Mining Company to accept the position of superintendent in charge of the development work for the Boulder Fluorspar & Radium Company, at Jamestown, Colo.

Milton Sutherland recently arrived in the United States from Manila to make an examination of property along the Mother Lode. He expects to remain in the United States until the first of the year and will visit mines in various parts of the country.

C. F. Burt, formerly superintendent of the Angangueo unit of the American Smelting & Refining Company at Angangueo, Michoacan, Mexico, is now employed by Cia. de Real del Monte y Pachuca, at Pachuca, Hidalgo, Mexico.

John Renning, a South Dakota School of Mines man, has joined the staff of Batong-Buhay Gold Mines, Inc., in the Philippines, as assistant superintendent. He was formerly on

the staff of the Canyon Corporation, Deadwood, S. D.

George A. Broomell left the Philippines in July for Africa to do mine examination work in Kenya, Tanganyika, and Southern Rhodesia for a group of Manila mining men. He expects to return to his home in Santa Ana, Calif., for a short vacation early in 1938.

H. H. Lauer, for the past two years head administrative officer of the Cement Plant Project of the Puerto Rico Reconstruction Administration, San Juan, Puerto Rico, returned to New York on Dec. 7 to enter consulting and engineering work on cement and industrial plants.

Frank G. McCutcheon, formerly with the Evans-Wallower Zinc Company, has joined the staff of the Eagle-Picher Mining & Smelting Company, Henryetta, Okla, where this company is installing sintering machines, Cottrell precipitator, and a cadmium plant.

A. Chester Beatty has purchased the former Freemasons' Hospital in Fulham Road, London, S.W., and is giving it to the Royal Cancer Hospital to house that hospital's Research Institute. Mr. Beatty will also equip the building with modern X-ray apparatus. The total sum involved in the gift is about £50,000.

T. P. Lane has been appointed manager of the Tungsten Metals Corporation, which is operating a tungsten mine and mill near Ely, Nev. Mr. Lane formerly had charge of the Saltchuck mine for the Alaska Palladium Company, and also, later, of the Lucky Jim Lead & Zinc Company's property at Zincton, B. C.

Earle W. Berry, who for several years has been engaged in mining in the United States, Mexico, and Philippine Islands, has returned to the Islands, where he has been for the past year in charge of the Batong-Buhay Gold Mines, Inc., as general superintendent. The mines are at Lubuagan, Kalinga, Mountain Province, P. I.

Louis V. Bender has retired as general superintendent of the Anaconda Reduction Works at Anaconda, Mont., where he had been in active service for the last 34 years. He will be replaced by **William E. Mitchell,** assistant general superintendent at the Great Falls Reduction Works. **Floyd S. Weimer,** of the Great Falls plant, will succeed Mr. Mitchell.

H. E. Nyberg has resigned as general manager of the Cia Minera "Las Dos Estrellas" en El Oro and Tlalpujushua, which position he has filled for the past seventeen years. Previous to this time he filled the various positions of chief engineer, efficiency engineer, and assistant manager. **D. M. Robertson,** formerly the mine superintendent for this same company, has been chosen to fill the position left vacant by Mr. Nyberg.

A. M. Swartley has changed his address from Corvallis, Oregon, to 704 Lewis Building, Portland, Oregon. He is now consulting engineer for the State Department of Geology and Mineral Industries.

H. H. Schlapp, who in earlier years was superintendent of the Pueblo Smelting Works, in Colorado, but who has been in Australia since 1886, was recently elected an honorary member of the Australasian Institute of Mining and Metallurgy, in recognition of his valuable services in the development of mining and metallurgy in Australia. Twice previously only has this distinction been accorded.

R. S. Eskridge, consulting mining engineer of Seattle, Wash., has spent the last forty days examining properties near Magdalena, Sonora, Mexico. These properties were reported to have been formerly operated on a large scale by the Spaniards. The installation of machinery and the progress of work on the Jojoba and San Miguel mines, owned and operated by the Magdalena Mining & Milling Company of Seattle, was also checked and supervised by Mr. Eskridge.

Reginald A. Brett has resigned as engineer in charge at Franco-American Mine and Homby Gold Mines, Helen, Ga., to take charge of prospecting and exploration for a Canadian-American syndicate in Sarawak, Borneo, and the Celebes. Mr. Brett completed the installation of a 30-ton flotation-concentration plant at Franco-American mine and made two clean-ups before leaving. He may be reached at 3208 Coleman Road, Kansas City, Mo., until his Singapore office is opened.

Henry H. Ray, former superintendent of the Benguet Consolidated Mines, in the Philippine Islands, has taken over the position of resident engineer for the Nancy Lee Mines, Inc., in the Keystone district of Montana, operated by Coeur d'Alene district mining men. Ray, a graduate of the University of California, has had 31 years of mining experience. Consulting engineers for the Nancy Lee will be **Frank Eichelberger,** of Wallace, Idaho; **Alexander Leggatt,** of Butte, Mont., and **Oscar Hershey,** of San Francisco.

Daniel C. Jackling, of San Francisco, president of Utah Copper Company, a subsidiary of Kennecott Copper Corporation, has been elected president of the Americal Institute of Mining and Metallurgical Engineers, succeeding **R. C. Allen,** of Cleveland, Ohio. Mr. Jackling was a pioneer in the successful treatment of low-grade porphyry copper ores. He is an alumnus of the Missouri School of Mines and has had a noteworthy career in mining and metallurgy. A biographical account of Mr. Jackling's achievements was presented in *Engineering and Mining Journal* of July 8, 1922.

Prof. George W. Swenson, head of the electrical engineering department of Michigan College of Mining and Metallurgy, at Houghton, was elected president of the north-midwest section of the Society for the Promotion of Engineering Education at the association's recent election held in Milwaukee. **N. H. Manderfield,** head of Michigan Tech.'s metallurgy department, was named secretary, and **Dr. James Fisher,** head of the college's physics department, was placed in charge of the mechanics section of the organization. Other officers are **Professor Kurtz,** of the University of Iowa, vice-president; and **Professors Orth,** of Wisconsin; **Hemstead** of Iowa State College; and **Hebard,** of Marquette University, members of the board of directors.

Alfred R. Zent, of Arizona, formerly with Inspiration Copper Company, Cia. Inversiones del Oro, Andes Copper, and the United States National Park Service in Arizona, has recently been made mechanical superintendent of the Cuban Mining Company at Cristo, Cuba. Since locating in Cuba Zent has gone in for raising game cocks. His birds are said to be known all over the island as "Zent's Killers." When not busy in the mechanical department of the company, he devotes himself to his chickens, seeing that they receive the correct amount of corn, raw meat, and wine.

Merle H. Guise, mining engineer, of Fairbanks, Alaska, is in New York, where he is stopping at the Hotel Taft. Mr. Guise was elected president of Peters Creek Mining Company, of Alaska, at the annual meeting of the company held in Spokane, Wash., on Nov. 8. The dragline equipment designed and installed on Peters Creek in 1935, for Pat. McDonald, Inc., the operating company, by McDonald and Guise, has been highly successful, handling more than five times as much yardage as the former hydraulic operations, though operated at half the cost.

John Gross, mining and metallurgical engineer, was recently retired from the service of the United States Bureau of Mines because of physical disability. His retirement follows more than 45 years of professional and scientific activities. Mr. Gross was born at Burlington, Iowa, on Nov. 11, 1874. After two years at a smelter at San Luis Potosi, Mexico, he entered the Colorado School of Mines in 1893 and was graduated with the degree of mining and metallurgical engineer in 1897. After several years of varied experience in the mining field Mr. Gross joined the staff of the Bureau of Mines at Fairbanks, Alaska, in 1917. Some of his outstanding accomplishments include: the establishment of the validity of Rittenger's law of grinding; demonstration that precious metals could be precipitated by charcoal and recovered by flotation; and development of explosion and nozzle crushing and the demonstration that sulphur dioxide and other deleterious substances can be removed from smelter fume as a valuable byproduct, through the action of ammonia and steam. Mr. Gross is the author of many articles relating to these subjects, and to the metallurgy of gold and silver, which have appeared in technical journals or as Bureau of Mines papers. His comprehensive bulletin on crushing and grinding of ores is soon to be published by the Bureau of Mines.

An Appreciation of William Kelly

WILLIAM KELLY

▶ *In fitting recognition of the passing of William Kelly, who for so many years occupied a unique position in the esteem of the mining executives, educators, and students of Northern Michigan, as well as in the warm regard of a much wider circle of friends and acquaintances outside that area, the Editor has asked Mr. James MacNaughton, of Calumet, Mich., president of Calumet & Hecla Consolidated Copper Company and long an outstanding figure of the Northern Peninsula, to contribute an appreciation of Mr. Kelly, his intimate friend. Mr. MacNaughton's remarks follow:*

The death of William Kelly on Oct. 1 marked the passing of one of the few remaining iron mine managers of Michigan, the period of whose activities included the last decade of the nineteenth century. During his managership Mr. Kelly witnessed and was a party to the many changes in mining methods on the older iron ranges, made necessary by competition of the much less costly production of ore from the open-pit mines of the Mesabi Range, which development began in the early 'nineties.

Mr. Kelly graduated from Yale in 1874 and from Columbia School of Mines in 1877. In 1924 he was honored with the degree of doctor of engineering by Rensselaer Polytechnic Institute, and in 1930 with the degree of doctor of science by the Michigan College of Mining and Technology. He was a member of the board of control of the Michigan College of Mining and Technology for a period of 33 years, during most of which time he served as chairman of the board. The reputation for the present high standing of the college is due in no small degree to Mr. Kelly's work and influence in its behalf.

Subsequent to his graduation, Mr. Kelly had one or two minor positions in Pennsylvania, and in 1889 was transferred to Michigan, where he became assistant mine manager of the Penn Iron Mining Company. Within a year he was appointed general manager of mines for the same company, a position he held through two or three succeeding ownerships until he resigned in 1923. His administration as manager was most successful and was marked by an untiring solicitation on his part for the welfare of the employees, as well as by his activities in all civic movements for the betterment of the community and State in which he lived. During his entire career he was held in the highest esteem by the mining men, the educators, and the mining students of Northern Michigan.

As a citizen he was deeply interested in all affairs of government and observed most faithfully his obligations to it.

As a man, his character was an inspiration to young and old alike—always cheerful, always kind, always considerate of others, broadminded and generous.

As a friend—understanding, faithful and loyal.

JAS. MACNAUGHTON.

OBITUARY

A. J. C. Nettell, for nineteen years connected with the Vancouver Branch of the Canadian Geological Survey, died on Oct. 23 at Vancouver, in his 66th year.

Professor T. Nelson Dale, retired, who for 23 years was with the United States Geological Survey, died in Pittsfield, Mass., on Nov. 16 at the age of 92.

William C. Dale, a Cornish miner who pioneered in Chile 59 years ago, settling at Copiapo, famous mining town on the Atacama desert, died at Copiapo recently at the age of 87.

Thomas H. Graham, internationally known aerial and tramway erector, contractor, and official of the Riblet Tramway Company, died recently at Spokane, Wash., at the age of 69.

F. G. A. Roberts, long associated with mining on the Rand, and since 1914 technical adviser to the Transvaal Chamber of Mines, died recently. He went to the Transvaal from Cornwall 48 years ago and had been identified with many large mining properties in that region.

William Brazenall, in earlier years associated with the gold-dredging industry in Australia and in America, and subsequently engaged in antimony smelting at Weaverville and Harbor City, in California, and later in Victoria and New South Wales, died recently at Tenterfield, in New South Wales.

James E. Gyde, 73, pioneer attorney of the Coeur d'Alenes, died at his home in Wallace on Nov. 17. He came to the district in 1891, building up a legal practice and becoming one of the state's leading attorneys. Mr. Gyde played an important role in many of the mine litigation cases of the State.

Oliver Powers, 65, mine superintendent for the Atok Gold Mining Company at its Big Wedge property, in the Baguio district in the Philippines, was killed by falling rock underground on Sept. 22. A graduate of the Colorado School of Mines, class of 1902, Mr. Powers had some 30 years' experience in the Western United States and in Mexico before going to the Philippines in May, 1937.

Daniel W. Lynch, 68, general manager of the Hidden Treasure Mine, in the Ophir district of Utah, 50 miles southwest of Salt Lake City, died on Nov. 9 of injuries sustained while riding in a skip. For 46 years Mr. Lynch had operated leases in the Hidden Treasure Mine. In late years, he became general manager of the Hidden Treasure Mining & Development Company, of Philadelphia.

Joseph Lyman Silsbee, 58, manager of the Bonneville, Ltd., died on Nov. 3 in Salt Lake City of heart disease. He was born in Syracuse, N. Y., June 16, 1879, and graduated from Harvard in 1902. Mr. Silsbee had won a considerable reputation for his work of pioneering the development of the Bonneville Flat salt brines, adjacent to Great Salt Lake. An organizer of the Utah-Salduro Company, he directed operations that produced a large quantity of potash from Great Salt Lake brines during the War.

Benjamin Lissberger, chairman of the board of the Federated Metals Division of American Smelting & Refining Company, died in New York on Nov. 18 in his 62d year. He was widely known in the non-ferrous metal trades. During the War he handled all non-ferrous metal buying for the British Government. He was a pioneer in the development of tin plate in the United States, and, with Charles M. Schwab, owned and controlled the United Zinc Smelting Company, in Moundsville, W. Va.

H. W. Turner, mining engineer, geologist, and writer, died in Ross, Calif., on Nov. 26, at the age of 80. Mr. Turner studied geology at Cornell and at George Washington and Leipzig universities. He was a member of the United States Geological Survey from 1892 to 1900. Later he did professional work in England, Russia, and the United States. He was a member of the A.I.M.E., the Geological Society of America, the Mining and Metallurgical Society of America, the Institute of Mining and Metallurgy, of London, and the Uralian Scientific Society of Ekaterinburg, Russia.

Summary of the

MARKETS

BUSINESS ACTIVITY during November continued to recede, and the trend in prices again was downward. The *E.&M.J.* index of non-ferrous metal prices was lowered from 85.26 in October to 78.91 in November. The high for the current year was 103.78, in March. Price reductions occurred in copper, lead, zinc, tin, antimony, quicksilver, platinum, manganese ore, and tungsten ore. Lower prices failed to stimulate activity, as purchasing agents in most instances were intent on reducing inventories.

Domestic copper declined 1c. per pound, closing the month at 10¾c., Valley. (On Dec. 1 the price dropped to 10½c.) The export quotation averaged about 1c. per pound under the domestic basis throughout the month. Business booked during November in the domestic market showed no improvement, totaling 21,035 tons. Actual consumption of copper in this country at present is estimated at less than 55,000 tons. The rate of consumption is still falling, traders believe, and sharp curtailment in output is called for under the circumstances. Production is being restricted throughout the industry. The large mine producers of copper followed the decline in prices, initiated by a custom smelter, reluctantly. Throughout the month the quotation of the mining division was above that named by those who had to sell copper in the open market against current intake. Sales in Europe by the Cartel were satisfactory, amounting to about 80,000 tons in November.

Lead business improved a little after producers lowered the price to the basis of 5c., New York. However, the market was far from active as the month ended. The tone was steady.

Zinc imports into the United States in the first ten months of 1937 amounted to 35,751 tons, against 10,036 tons in the same period last year. Stocks here have been increasing, demand is dull, and the price fell to 5¼c., St. Louis.

Tin prices broke sharply, but steadied late in the month on rumors that the International Tin Committee will ask for an even deeper cut in output for the first quarter.

There was no official word from Washington on the status of the silver program.

Steel production in the United States declined to 29.6 per cent of capacity at the end of November, against 48.6 per cent a month ago.

UNITED STATES MARKET

1937 Nov.	Electrolytic Copper Domestic (a)	Electrolytic Copper Export (b)	Straits Tin New York	Lead New York	Lead St. Louis	Zinc St. Louis
1	11.525	10.600	47.625	5.50	5.35	5.75
2	Holiday	10.500	Holiday	Holiday	Holiday	Holiday
3	11.525	10.300	46.000	5.25	5.10	5.75
4	11.275	10.250	45.125	5.00	4.85	5.75
5	10.775	9.900	44.250	5.00	4.85	5.75
6	10.775	9.900	43.875	5.00	4.85	5.75
8	10.775	9.325	42.250	5.00	4.85	5.75
9	10.775	9.850	43.000	5.00	4.85	5.75
10	10.775	9.850	44.375	5.00	4.85	5.75
11	Holiday	10.150	Holiday	Holiday	Holiday	Holiday
12	10.775	10.200	45.500	5.00	4.85	5.75
13	10.775	10.250	45.250	5.00	4.85	5.75
15	10.775	10.250	45.000	5.00	4.85	5.75
16	10.775	9.975	43.000	5.00	4.85	5.75
17	10.775	9.850	42.875	5.00	4.85	5.75
18	10.775	9.800	41.500	5.00	4.85	5.75
19	10.775	9.500	41.750	5.00	4.85	5.75
20	10.775	9.450	41.125	5.00	4.85	5.75
22	10.775	9.450	41.000	5.00	4.85	5.50
23	10.525	9.400	41.625	5.00	4.85	5.50
24	10.525	9.425	41.750	5.00	4.85	5.50
25	Holiday	9.500	Holiday	Holiday	Holiday	Holiday
26	10.525	9.500	41.750	5.00	4.85	5.25
27	10.525	9.500	42.375	5.00	4.85	5.25
29	10.525	9.700	42.375	5.00	4.85	5.25
30	10.525	9.725	42.500	5.00	4.85	5.25
For month Average	10.797	9.850	43.299	5.033	4.883	5.630
AVERAGES FOR WEEK						
Nov 3	11.550	10.554	47.775	5.450	5.300	5.750
10	10.858	9.846	43.813	5.000	4.850	5.750
17	10.775	10.113	44.325	5.000	4.850	5.750
24	10.692	9.504	41.458	5.000	4.850	5.625
CALENDAR WEEK AVERAGES						
Nov 6	11.175	10.242	45.375	5.150	5.000	5.750
13	10.775	9.938	44.075	5.000	4.850	5.750
20	10.775	9.804	42.542	5.000	4.850	5.750
27	10.575	9.463	41.700	5.000	4.850	5.400

SILVER, GOLD, AND STERLING EXCHANGE
NEW YORK AND LONDON

1937 Nov.	Sterling Exchange "Checks"	Sterling Exchange "90-day demand"	Silver (c) New York	Silver London	Gold London	Gold (d) United States
1	4.96000	4.95250	44.750	19.8750	140s 5½d	$35.00
2	Holiday	Holiday	Holiday	19.9375	140s 6½d	Holiday
3	4.96500	4.95750	44.750	19.8750	140s 7 d	35.00
4	4.97750	4.97000	44.750	19.8125	140s 6½d	35.00
5	4.99125	4.98500	44.750	19.6875	140s 6 d	35.00
6	5.00000	4.99375	(e)	19.6250	140s 4 d	35.00
8	5.02375	5.01625	44.750	19.5625	140s ½d	35.00
9	5.00750	5.00125	44.750	19.6250	140s	35.00
10	5.00000	4.99250	44.750	19.6875	140s 2 d	35.00
11	Holiday	Holiday	Holiday	19.8125	140s 1½d	Holiday
12	4.98375	4.97625	44.750	19.8125	140s 4½d	35.00
13	4.98250	4.97375	(e)	19.7500	140s 4 d	35.00
15	4.99125	4.98250	44.750	19.6250	140s 1 d	35.00
16	5.00750	5.00000	44.750	19.6875	139s 11½d	35.00
17	5.00500	4.99625	44.750	19.6250	139s 10d	35.00
18	5.00000	4.99125	44.750	19.6875	140s	35.00
19	5.00125	4.99250	44.750	19.6875	140s 1 d	35.00
20	5.00500	4.99750	(e)	19.6250	140s	35.00
22	5.00250	4.99500	44.750	19.6250	140s 1 d	35.00
23	5.00250	4.99375	44.750	19.6875	140s	35.00
24	5.00000	4.99125	44.750	19.6250	140s 1 d	35.00
25	Holiday	Holiday	Holiday	19.6875	140s	Holiday
26	4.99125	4.98375	44.750	19.6875	140s 1 d	35.00
27	4.99500	4.98750	(e)	19.6875	140s	35.00
29	4.99250	4.98500	44.750	19.7500	139s 11½d	35.00
30	4.99250	4.98375	44.750	19.6250	139s 11 d	35.00
Average for Mo.	4.99467	.....	44.750	19.707	.....	35.00
AVERAGES FOR WEEK						
Nov. 3	4.96075	.....	44.750	.....	.....	.....
10	5.00000	.....	44.750	.....	.....	.....
17	4.99400	.....	44.750	.....	.....	.....
24	5.00188	.....	44.750	.....	.....	.....

Calendar week averages: New York Silver, Nov. 6th, 44.750; 13th 44.750; 20th, 44.750; 27th, 44.750.

(e) No quotation (Saturday)

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis, add 0.225c. per pound, the average differential for freight and delivery charges.

(b) Export prices are net at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. Most sales in the foreign market are made on the basis of c.i.f. usual ports of destination—Hamburg, Havre, and Liverpool. The c.i.f. basis commands a premium of 0.300c. per pound above our refinery quotation.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes are sold at a discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c. per pound over the current market for Prime Western but not less than 1c. over the *E. & M. J.* average for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(c) Silver other than newly mined domestic. Under Executive order issued April 24, 1935, the U. S. Government's price on newly mined domestic silver was established at 77.57. Handy & Harman's quotation for domestic silver, .999 fine, was 77c. per ounce throughout November.

(d) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in domestic and imported ore or concentrate is at 99.75 per cent of the price quoted by the Treasury, which at present is equal to $34.9125 per ounce.

PRICES OF METALS • MISCELLANEOUS QUOTATIONS

LONDON MARKET

1937 Nov.	COPPER Standard Spot	COPPER Standard 3 months	COPPER Electro Bid	TIN Standard Spot	TIN Standard 3 months	LEAD Spot Buyers	LEAD Spot Sellers	LEAD 3 months Buyers	LEAD 3 months Sellers	ZINC Spot Buyers	ZINC Spot Sellers	ZINC 3 months Buyers	ZINC 3 months Sellers
1	42.8750	43.1875	48.5000	206.2500	206.2500	17.6875	17.7500	17.7500	17.8125	16.6250	16.7500	16.9375	17.0000
2	41.6875	42.0000	47.0000	202.0000	202.0000	17.2500	17.3125	17.3750	17.4375	16.4375	16.5000	16.6875	16.7500
3	41.2500	41.5625	46.0000	199.5000	199.5000	17.1250	17.1875	17.1875	17.2500	16.3125	16.3750	16.5625	16.6250
4	40.3750	40.6875	45.5000	198.0000	197.7500	16.8750	16.9375	16.8750	16.9375	16.1250	16.1875	16.3750	16.4375
5	39.2500	39.6250	44.0000	192.5000	192.0000	16.2500	16.3125	16.2500	16.3125	15.3750	15.4375	15.6250	15.6875
8	36.1875	36.5625	42.0000	181.2500	180.2500	15.5625	15.6250	15.5625	15.6250	14.7500	14.8125	14.9375	15.0000
9	39.4375	39.8125	43.5000	188.5000	187.2500	16.0625	16.1875	16.1250	16.1875	15.5000	15.5625	15.6875	15.7500
10	39.1250	39.4375	43.5000	192.2500	191.5000	17.0000	17.1250	17.0625	17.1250	15.8750	16.0000	16.1250	16.1875
11	41.1875	41.5000	46.0000	204.7500	204.0000	17.6250	17.6875	17.7500	17.8125	16.8750	16.9375	17.0625	17.1250
12	41.0000	41.2500	46.0000	198.5000	197.5000	17.6250	17.6875	17.7500	17.8125	16.6875	16.7500	16.8750	16.9375
15	41.3750	41.6875	46.5000	197.0000	196.5000	17.6875	17.7500	17.7500	17.8125	16.6250	16.7500	16.8750	17.0000
16	39.3125	39.6250	44.0000	187.7500	187.0000	17.3125	17.3750	17.3125	17.3750	16.1250	16.1875	16.2500	16.3125
17	39.3750	39.6250	44.0000	188.0000	187.7500	17.3125	17.3750	17.3125	17.3750	16.1250	16.1875	16.2500	16.3125
18	38.1250	38.4375	43.0000	181.5000	181.5000	17.0000	17.0625	17.0000	17.0625	15.6250	15.7500	15.7500	15.8750
19	37.5625	37.8125	42.0000	183.0000	183.0000	16.6875	16.7500	16.6875	16.7500	15.3750	15.4375	15.5625	15.6250
22	37.5625	37.8125	42.0000	183.2500	183.0000	16.0000	16.0625	16.0000	16.0625	15.2500	15.3125	15.3125	15.3750
23	37.0000	37.2500	41.5000	181.0000	180.5000	16.1250	16.2500	16.0000	16.1250	14.8750	14.9375	15.0625	15.1250
24	37.8125	38.0625	42.0000	186.0000	185.7500	16.1250	16.1875	16.0625	16.1250	15.2500	15.3125	15.3750	15.4375
25	37.5625	37.8125	42.0000	180.7500	180.7500	15.6875	15.8125	15.6250	15.6875	14.7500	14.8125	14.9375	15.0000
26	37.8750	38.1250	42.0000	183.0000	183.0000	15.5000	15.6250	15.5000	15.5625	15.1250	15.2500	15.1875	15.2500
29	40.4375	40.6875	44.5000	190.7500	190.0000	16.3125	16.3750	16.3125	16.3750	15.8125	15.9375	15.8125	15.9375
30	38.6875	38.9375	43.0000	185.0000	184.7500	15.8750	15.9375	15.7500	15.8125	15.3750	15.5000	15.3125	15.3750
Av'ge for month	39.321	.....	44.023	190.477	.....	16.706		16.714		15.808		15.970	

Prices for lead and zinc are the official prices for the first session of the London Metal Exchange; prices for copper and tin are the official closing buyers' prices. All are in pounds sterling per long ton of 2,240 lb.

CURRENT PRICES—MISCELLANEOUS METALS, ORES, AND NON-METALLIC MINERALS

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated

(December 1, 1937)

MISCELLANEOUS METALS

Aluminum, ingot, 99 plus per cent, lb	20c.
Antimony, domestic, spot, lb	14.750c.
Bismuth, ton lots, lb	$1.00
Cadmium, lb	$1.25 @$1.60
Calcium, lb., ton lots 98 @ 99 per cent	75c.
Chromium, 97 per cent grade, lb	85c.
Nickel, electrolytic cathodes, lb	35c.
Magnesium, 99.8 per cent, carloads, lb	30c.
Palladium, troy oz	$24.00
Platinum, (Official quotation) troy oz	$40.00
Quicksilver, flask of 76 lb., 100 flasks or more	$83.00@$84.00
Radium, mg. radium content	$40.00
Selenium, 99.5 per cent, lb	$2.00
Silicon, minimum 97 per cent, spot, lb	16.50c.
Tellurium, lb	$1.75@$2.00
Thallium, 100 lb. or more, lb	$6.50
Titanium, 96 to 98 per cent, lb	$6.00
Zirconium, commercially pure, lb	$7.00

METALLIC ORES

Beryllium Ore, f.o.b. mines, ton	$30.00@$35.00
Chrome Ore, 45 @ 47 per cent, c.i.f. Atl. ports, long ton	$22.00@$23.00
Iron Ore, Lake Superior, Lower Lake ports, long ton:	
Old Range bessemer	$5.25
Mesabi bessemer	$5.10
Old Range non-bessemer	$5.10
Mesabi, non-bessemer	$4.95
Lead (Galena) 80 per cent Joplin, Mo., ton	$56.22
Manganese Ore, c.i.f. Atlantic ports, long ton unit:	
52 @ 55 per cent	45c.
50 @ 52 per cent	45c.
44 @ 48 per cent	40c.
Molybdenum Ore, 90 per cent, per lb. of contained MoS_2	42c.
Tungsten Ore, per unit of WO_3:	
Chinese duty paid	a$23.00@$23.50
Domestic Scheelite	a$22.00@$23.00
Vanadium Ore, per lb. of contained V_2O_5	27½c.
Zinc, Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton.	$32.00

(a) Nominal.

METALLIC COMPOUNDS

Arsenious Oxide (arsenic) lb	3c
Cobalt Oxide, 70 @ 71 per cent, lb	$1.67@$1.77
Copper Sulphate, 100 lb	$4.50
Sodium Nitrate, ex vessel, in 200-lb. bags, per 100 lb	$1.34
Sodium Sulphate, bulk, ton	$13.00@$15.00

ALLOYS

Beryllium Copper, Master alloy, 2.5 to 3 per cent Be, per lb. of contained Be	$23.00
Ferrochrome, 65 @ 70 per cent chromium, 4 @ 6 per cent carbon, lb	10½c.
Ferromanganese, 78 @ 82 per cent, gross ton	$102.50
Ferromolybdenum, 50 @ 60 per cent Mo, lb. of Mo contained	95c.
Ferrosilicon, 50 per cent, gross ton	$69.50
Ferrotungsten, 75 @ 80 per cent, lb. of W contained	Nominal

NON-METALLIC MINERALS

Asbestos, f.o.b. mines ton:	
Canadian (Quebec)	
Crude No. 1	$550@$600
Crude No. 2	$200@$225
Spinning fibers	$90@$170
Paper stock	$32.50@$37.50
Shorts	$11@$14.50
Vermont	
Shingle stock	$47.50.....
Paper stock	$35 @.....
Cement stock	$23 @.....
Barytes, long ton:	
Georgia, crude	$7.00
Missouri, 90 per cent $BaSO_4$, less than 1 per cent iron	$6.00@$7.00
Bauxite, long ton:	
Domestic, chemical, 55 @ 58 per cent	$6.50@$7.50
Domestic, abrasive, 70 @ 84 per cent	$12.50@$15.00
Dalmatian, 50 @ 55 per cent	(a)$6.50@$7.50
French, 56 @ 59 per cent	(a)$8.00@ 9.00
China Clay, f.o.b. mines, ton:	
South Carolina and Georgia, bulk	$6.50@$8.50
Delaware, No. 1	$14.50@.....
Feldspar, bulk, ton:	
Potash feldspar, 200 mesh	$17.00
Glass-spar, white, 20 mesh	$11.75
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 85–5 per cent, all rail movement, ton	$20.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00@$14.00
Magnesite, per ton:	
Dead-burned, f.o.b. California	$25.00@.....
Dead-burned, f.o.b. Washington	$25.00@.....
Mica, per lb., North Carolina, No. 1 and 2 quality:	
1½ x 2 in	15@40c.
2 x 2 in	30@60c.
3 x 3 in	75@$1.20
3 x 4 in	$1.00@$1.40
4 x 6 in	$2.00@$2.50
White, ground, 70 mesh, ton	$60.00@$80.00
Ocher, Georgia, ton	$19.00@$22.00
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports	(a) 12@12½c
Silica, water-floated, in bags, 325 mesh, ton	$16.00@$40.00
Sulphur, Texas mines, long ton	$18.00@.....
Talc, f.o.b. works, ton:	
New York, double air-floated, 325 mesh	$12.00@$15.00
New Jersey, mineral pulp	$8.00@$10.00
Vermont, extra white, 200 mesh	$9.00@ $9.50
Tripoli, Missouri, ton:	
40 mesh, cream colored	$15.00@.....
200 mesh, cream colored	$25.00@.....

(a) Nominal.

IRON AND STEEL

Pig Iron, Valley furnaces, gross ton:	
Bessemer	$24.50
Basic	$23.50
No. 2 Foundry	$24.00
Steel, base prices, Pittsburgh:	
Billets, gross ton	$37.00
Structural shapes, 100 lb	$2.25
Bars, 100 lb	$2.45

Monthly and Yearly

AVERAGE PRICES

SILVER AND STERLING EXCHANGE

	New York		London Spot		Sterling Exchange	
	1936	1937	1936	1937	1936	1937
January	47.250	44.913	20.250	20.734	496.115	490.670
February	44.750	44.750	19.796	20.083	499.908	489.307
March	44.750	45.130	19.663	20.677	496.952	488.412
April	44 892	45.460	20.245	20.740	494.139	491.524
May	44.869	45.025	20.248	20.346	496.850	493.835
June	44.750	44.818	19.770	20.022	501.817	493.404
July	44.750	44.750	19.590	19.986	502.178	496.582
August	44.750	44 750	19.490	19.848	502.519	498.043
September	44.750	44.750	19.579	19.889	503.455	495.145
October	44.750	44.750	19.977	19.942	489.755	495 395
November	45.431	44.750	21.050	19.707	488.727	499.467
December	45.352	.....	21.238	.....	490.670	.....
Year	45.087	.....	20.075	.....	496.924	.....

New York quotations for silver not eligible for sale to U. S. Government, cents per ounce troy, 999 fine. London, pence per ounce sterling silver 925 fine. Sterling exchange in cents.

COPPER

	F.O.B. Refinery, Electrolytic				London Spot			
	Domestic		Export		Standard		(a) Electrolytic	
	1936	1937	1936	1937	1936	1937	1936	1937
January	9 025	12.415	8.358	12.112	34.706	51.497	38.788	56.497
February	9.025	13.427	8.566	13.828	35.313	59.225	39.463	64.013
March	9.025	15.775	8.708	16.590	36.040	72.339	40.227	76.167
April	9.169	15.121	8.849	14.692	36.975	62.506	41.131	66.614
May	9.275	13.775	8.819	13.999	36.690	61.118	40.839	63.684
June	9.275	13 775	8.790	13.492	36.324	55.696	40.357	61.409
July	9.352	13.775	8.993	13.817	37.217	56.412	41.228	62.807
August	9.525	13.775	9.297	13.926	38.259	57.143	42.375	63.595
September	9.525	13.530	9.523	12.984	38.915	52.989	43.267	58.966
October	9.563	11.838	9.669	11.207	40 980	45.384	45.295	50.619
November	10.161	10.797	10 349	9.850	43.932	29.321	48.467	44.023
December	10.763	..	10.835	.....	45.946	.....	50.364	.....
Year	9.474	.....	9.230	.....	38.441	.....	42.650	.....

New York quotations, cents per pound. London, pounds sterling per long ton, (a) Bid quotation.

LEAD

	New York		St. Louis		London			
	1936	1937	1936	1937	1936 Spot	1936 3 Mos.	1937 Spot	1937 3 Mos.
January	4.500	6.000	4.350	5.850	15.397	15.494	27.272	27.150
February	4.515	6.239	4.365	6.089	16.022	16.141	28.319	28.328
March	4.600	7.190	4.450	7.040	16.608	16.767	33.027	32.979
April	4.600	6.175	4.450	6.025	16.097	16.234	26.014	25.878
May	4.600	6.000	4.450	5.850	15.530	15.601	24.000	23.891
June	4.600	6.000	4.450	5.850	15.170	15.259	22.878	22 759
July	4.600	6.000	4.450	5.850	15.856	15.954	23.932	23.703
August	4.600	6.452	4.450	6.302	16.772	16.859	22.606	22.670
September	4.600	6.400	4.450	6.250	18.009	17.974	20.990	21.044
October	4.631	5.740	4.488	5.590	18.446	18.375	18.259	18.318
November	5.114	5.033	4.964	4.883	21.723	21.693	16.706	16.714
December	5.554	.....	5.406	.....	25.560	25.503	.....	.....
Year	4.710	.....	4.560	.....	17.599	17.655	.....	.....

New York and St. Louis quotations, cents per pound. London pounds sterling per long ton.

TIN

	Straits New York		Standard, Spot London	
	1936	1937	1936	1937
January	47.234	50.925	209.731	229 350
February	47.962	52.010	207.081	233.750
March	48.037	63.043	213.080	282 988
April	46 963	59.172	209.313	267.136
May	46.352	55.651	202.429	250.645
June	42 204	55.851	183.167	249.852
July	43.021	59.245	185.957	263.540
August	42.579	59.465	183.731	264.595
September	44.754	58.675	194.676	258.943
October	44.975	51.654	201.193	223.869
November	51.392	43.299	230.869	190.477
December	51 823	.....	232.108	.....
Year	46.441	.....	204.445	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

ZINC

	St. Louis		London			
	1936	1937	1936 Spot	1936 3 Mos.	1937 Spot	1937 3 Mos.
January	4.848	5.847	14 488	14 719	21 153	21.281
February	4.859	6.465	15 125	15.391	25.122	25.322
March	4.900	7.381	15.983	16.190	33.188	33.405
April	4.900	7.010	15.181	15.334	26.216	26.344
May	4.900	6.750	14.536	14.777	23.092	23.365
June	4.880	6.750	13.896	14.122	21.409	21.528
July	4.783	6.923	13.579	13.826	22.568	22.693
August	4.800	7.192	13.528	13.759	24·140	24.290
September	4.850	7.190	13.906	14.159	21·406	21·607
October	4.850	6.085	14.554	14.835	17.722	17 955
November	4.974	5.630	16.301	16.554	15,808	15.970
December	5.273	.....	17.957	18.145	.....	.....
Year	4.901	.....	14.920	15.151	.....	.....

St. Louis quotations, cents per pound. London, pounds sterling per long ton

CADMIUM AND ALUMINUM

	Cadmium		Aluminum	
	1936	1937	1936	1937
January	105.000	90.000	20.000	19.500
February	105 000	90 000	20.000	19.500
March	105 000	101.667	20.000	20.000
April	105.000	105 000	20.000	20.000
May	105.000	105.000	20.000	20.000
June	105.000	130.962	20.000	20.000
July	93.462	142.500	20.000	20.000
August	90.000	142.500	20.000	20.000
September	90.000	142.500	20.000	20.000
October	90.000	142.500	20.000	20.000
November	90.000	142.500	20.000	20.000
December	90.000	.....	20.000	.....
Year	97.789	.....	20.000	.....

Aluminum in cents per pound, 99 per cent grade. Cadmium, cents per pound.

ANTIMONY, QUICKSILVER, AND PLATINUM

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1936	1937	1936	1937	1936	1937
January	12 736	14.130	76.769	90.250	36.885	50.404
February	12 967	14.563	77.000	91.000	35.000	64.360
March	13.072	16 375	77 000	91 778	34.115	58.000
April	12.673	16 043	76.731	92.000	32.846	58 000
May	12.410	14 830	74.940	95.520	32.000	54.800
June	11 707	14 702	74 192	96.654	36.346	53.000
July	11 245	14.803	73 423	93 904	39 308	50.115
August	11 125	15.327	73 923	91 423	49 577	51.000
September	11 740	16.555	85 280	89.020	68 960	51.000
October	12 058	16.935	89 240	86.140	54 074	48.560
November	12 233	15.848	90 250	83.435	48 000	43.652
December	12.918	.....	90.250	.....	48 000	..
Year	12.240	.....	79.917	.....	42.926	

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. (c) Platinum in dollars per ounce troy.

PIG IRON

	Bessemer		Basic		No. 2 Foundry	
	1936	1937	1936	1937	1936	1937
January	20.00	21.50	19.00	20.50	19.50	21 00
February	20.00	21.50	19.00	20.50	19.50	21.00
March	20.00	24.50	19.00	23 20	19.50	23.70
April	20.00	24.50	19.00	23.50	19.50	24.00
May	20.00	24.50	19.00	23.50	19.50	24 00
June	20.00	24.50	19 00	23.50	19.50	24 00
July	20.00	24.50	19.00	23.50	19.50	24.00
August	20.00	24.50	19.00	23.50	19.50	24 00
September	20.00	24.50	19.00	23.50	19.50	24.00
October	20.00	24.50	19.00	23.50	19.50	24.00
November	20.23	24.50	19.23	23.50	19.73	24.00
December	21.00	.....	20.00	.....	20.50	.
Year	20.103	.....	19.103	.....	19.603	....

Iron in dollars per long ton. F. o. b. Mahoning and Shenango Valley furnaces

What Metal Statistics Show

CURRENT base-metal statistics reveal the influence exerted on the mining industry by the sharp business decline that has forced lower metal prices, with consequent wage cuts, curtailment of operations, and unemployment. Practically all large copper producers in Arizona, Utah, Montana, and Nevada have found it necessary to curtail production and many small mines have been forced to lower output due to lack of demand for metal. Producers have been disappointed in witnessing a steady falling off in business from fabricators during the last six months, but many believe the necessary adjustments in production schedules during the next few months will benefit the copper industry later in 1938.

Actual consumption of copper estimated by the trade for October was about 55,000 tons, compared to an average of around 80,000 tons for the first six months of the year. Deliveries of copper to consumers (apparent consumption) showed a 33 per cent drop in October, compared with September, and stocks of refined metal increased 37,521 tons. Blister stocks decreased 6,013 tons, making the net increase in stocks 31,508 tons. Following is a summary of the statistics for September and October. (Previous copper statistics for the year are given in the October issue, p. 65.)

	Sept.	Oct.
Production (blister):		
U. S. mine	68,845	71,388
U. S. scrap, etc	14,900	9,410
Foreign mine	99,910	103,758
Foreign scrap, etc	13,155	12,441
Totals	196,810	196,997
Production, refined:		
United States	90,982	86,811
Foreign	106,347	109,548
Totals	197,329	196,359
Deliveries to customers:		
Domestic	66,229	44,592
Foreign	117,673	114,191
Totals	183,902	158,783
U. S. exports of domestic copper	6,616	4,698
Stocks, refined:		
United States	144,321	181,842
Foreign	200,417	200,472
Totals	344,738	382,314

New business booked by producers for domestic account has also declined sharply since August, as indicated in the following table:

	1936	1937
January	33,165	53,819
February	78,654	74,912
March	35,948	53,101
April	158,064	26,143
May	16,303	43,130
June	16,521	35,395
July	175,484	62,298
August	25,253	69,225
September	40,769	28,936
October	178,801	23,238
November	88,177	21,035
December	117,715	.....

▶ZINC. Production of zinc ore reached substantial levels in the first and second quarters of this year. Output was pressed to meet the demand for metal, and prices at one time reached attractive levels. A shortage of electrolytic zinc upset the industry earlier in the year, due to drouth conditions at hydro-electric plants in Montana. Foreign zinc had to be purchased to meet the emergency shortage, and the trade estimates that more than 30,000 tons were bought. The sharp reversal in business, however, resulted in the resale of some of this metal abroad. At present price levels, Prime Western zinc offers producers little incentive to continue operations at capacity, and curtailment more in line with actual needs will be brought about. Stocks of zinc are rapidly increasing.

A summary of the figures for August, September, October and November, in tons, all grades, follows:

	Aug.	Sept.	Oct.	Nov.
Production	48,309	50,027	52,645	49,388
Production daily rate	1,558	1,668	1,698	31,646
Shipments	50,643	47,737	40,345	32,221
Stock at end	11,227	13,517	25,817	42,984
Unfilled orders	106,187	92,319	75,086	61,151

Statistics of the Prime Western division, covering the ordinary grades, for the first ten months of the year follow:

	Production	Shipments	Stock At End
Jan	21,263	30,520	29,924
Feb	19,703	27,349	22,278
March	21,973	28,402	15,849
April	21,333	25,921	11,261
May	23,553	24,321	10,493
June	22,482	22,719	10,256
July	25,237	25,311	10,182
Aug	26,140	29,549	6,773
Sept	27,412	24,670	9,515
Oct	28,667	23,520	14,662
Nov	25,470	18,624	21,508

▶LEAD. Mines producing lead have maintained steady output during the year and stocks have declined monthly since July, 1936, but this trend was halted in October, when stocks increased 9,904 tons. This rise was larger than expected, but is accounted for by some smelters cleaning up accumulated surplus stocks of concentrates. The downward trend in price during the last two months will no doubt eventually restrict output in some directions. The following table presents the United States lead refinery statistics in tons of 2,000 lb. compiled by the American Bureau of Metal Statistics:

		Production		
1936	Stock at Beginning	From Domestic Ore	Secondary and Foreign	Total
Jan	222,306	34,086	2,208	36,296
Feb	224,013	32,221	1,906	34,127
Mar	225,010	32,184	2,966	35,150
Apr	223,388	36,175	1,898	38,073
May	220,991	39,558	1,993	41,551
June	229,409	36,756	2,062	38,818
July	230,481	36,863	2,713	39,576
Aug	231,081	31,117	2,425	33,542
Sept	218,233	29,788	3,194	32,982
Oct	200,517	39,317	2,839	42,156
Nov	183,430	40,273	3,558	43,831
Dec	176,960	43,613	3,291	46,904
Totals	.....	431,953	31,053	463,006
1937				
Jan	171,856	41,223	2,413	43,636
Feb	169,776	34,986	2,465	37,451
Mar	156,832	41,422	2,396	43,818
Apr	137,204	43,908	2,560	46,468
May	128,462	40,192	2,413	42,605
June	115,843	37,321	2,835	40,156
July	113,370	42,480	3,016	45,496
Aug	111,103	42,460	4,505	46,965
Sept	103,518	37,989	3,057	41,046
Oct	90,742	45,112	4,085	49,197
Totals	.....	407,093	29,745	436,838

	Total Supply	Stock at End	Domestic Shipments
Jan., 1936	258,602	224,013	34,590
Feb., "	258,140	225,010	33,086
Mar., "	260,160	223,388	36,743
Apr., "	261,461	220,991	4(,457
May, "	262,542	229,409	33,125
June, "	268,227	230,481	37,736
July, "	270,057	231,081	38,996
Aug., "	264,623	218,233	46,388
Sept., "	251,215	200,517	50,685
Oct., "	242,673	183,430	59,210
Nov., "	227,261	176,960	50,313
Dec., "	223,864	171,856	52,032
Totals	685,312	.....	513,361
Jan., 1937	215,492	169,776	45,718
Feb., "	207,227	156,832	50,375
Mar., "	200,650	137,204	63,425
Apr., "	183,672	128,462	55,200
May, "	171,067	115,843	55,212
June, "	155,999	113,370	42,710
July, "	158,866	111,103	47,727
Aug., "	158,068	103,518	54,551
Sept., "	144,564	90,742	53,850
Oct., "	139,939	100,646	39,292
Totals	608,694	.....	508,060

▶SILVER. Uncertainty over the future of the Administration's silver program makes it extremely difficult for producers of the metal to plan for the future. With business depressed, as at present, this uncertainty is exerting more of an influence on silver and those metals usually produced in conjunction with silver than would ordinarily be the case. Silver prices have not moved throughout the period of general weakness in other metals, but this favorable factor carries little or no weight in the present confused state of the market. Senator Key Pittman, of Nevada, demanded in the Senate on Nov. 22 that the Administration quickly announce its future silver purchase plans to alleviate uneasiness in the West. Senator King, of Utah, after conferring with Treasury officials late in November, said he did not believe

there would be any modification of the silver-purchase plan harmful to American mining interests. Secretary of the Treasury-Morgenthau on Nov. 29 is reported to have said he would not do anything about silver "until the end of December." At a press conference on Dec. 7, in reply to a question about 77.57c. domestic silver, President Roosevelt said he would be ready to give out news on the subject about Dec. 23 or 24.

California

Walker Mines Curtails Copper Production

Lower metal prices bring cut in output from 1,600 to around 300 tons daily, resulting in employment decrease — Two more gold dredges operating near Folsom

▶ After shutting down the Plumas County, California, properties of the Walker Mining Company on Nov. 2, officials decided to operate through the winter with a force of 80 men. Preference is being given to married men. Production will be at the rate of 9,000 tons a month, compared with an output of close to 50,000 tons monthly. One unit of the flotation plant will be operated on a part-time basis to treat the ore. About 500 men were thrown out of employment. L. F. Bayer is general superintendent.

▶ Two large units have been added to the existing fleet of dredges operating in central California. Capitol Dredging Company, F. C. van Deinse, vice-president and general manager, has recently completed the 18-cu.ft. dredge manufactured by Yuba Manufacturing Company, of San Francisco, known as No. 4, in the Nye Grammar School district near Folsom. The Natomas Company has just placed in operation the No. 8, a 12-cu.ft. unit, in the same area. Digging depth is 77 ft. and 67 ft. below water respectively. The Capitol dredge is equipped with a patented Perry bucket idler, and is second in size only to No. 17 of Yuba Consolidated, operating near Hammonton. Thomas McCormack is president of Natomas Company, with R. G. Smith, general superintendent, in charge of operations.

▶ Central Eureka Mining Company, C. C. Prior, president, has declared a dividend of 6c. on both common and noncumulative preferred stocks, the first disbursement since 1926. The 40-stamp mill at Sutter Creek, Amador County, is running at capacity on ore received from the 2,500 and 3,000 levels of the Eureka mine, where development of a large area of new ground has been in progress for several months. James Spiers directs operations at the property.

▶ The Ida Mayland Exploration Company, a new concern said to be controlled by Nevada and Canadian interests, has acquired the Penrose and King Ranch properties, in the Grass Valley-Nevada City district, from the Champion Mining Company, and is completing preparations for comprehensive developments. The properties adjoin the Idaho Maryland holdings on the east and the Lava Cap mines on the south, covering about 700 acres. Work to be started immediately includes installation of hoisting and compressor equipment, to be followed by sinking two shafts on the main ore channel, one on the Penrose group of claims and the other on the King Ranch holdings. E. W. Harker will direct the work. Officers of the new company are C. D. Terwilliger, president, Loyalton, Calif., and A. M. Robertson, vice-president.

▶ Good progress is being made by Western Gold, Inc., in rehabilitating the old Union Blue tunnel at the Lucky Jane gravel mine, at North Bloomfield, Nevada County, and a crew of men is employed at the company's Relief Hill hydraulic property near by repairing ditches and flumes for early hydraulic operations. C. E. Clark, general manager, is in charge of both mines.

▶ Tuco Gold Mining Company has reopened the old Doig mine, near Ophir, Placer County, and is reported to be developing a large quartz vein averaging 4½ ft. in width. Early installation of a 50-ton mill is planned. Steve M. Turich is general manager.

▶ According to a report from Jackson, preliminary arrangements are being completed by Mother Lode Gold Mines for sinking the main shaft at its mine near Sutter Creek an additional 500 ft. Enlargement of the present 50-ton mill to 100 or 125 tons is also planned. Walter Lucot is in charge of operations.

▶ Milling operations have been started at the property of Mother Lode Central Mines, Inc., Angels Camp, where a new 100-ton flotation mill was completed recently. At the mine, development work is in progress on the 200, 300, 400, and 500 levels. F. L. Macpherson is general superintendent.

▶ Following the purchase recently of the Finney mine, near Downieville, Sierra County, Ira Mahon and associates have completed rehabilitating underground workings and announce acquisition of the adjoining Oro property. Both mines will be operated under the supervision of Martin Miller.

▶ A tailings dam 25 ft. high is being constructed at a cost of $12,000 by the Lava Cap Gold Mining Corporation at its properties, the Central and Banner mines, near Nevada City, to obviate any possible pollution of water during the rainy season. The mill is reported to be treating more than 300 tons of ore a day, and about 250 men are now employed under the direction of Otto E. Schiffner, general manager.

▶ Construction of flumes and a débris dam is proceeding rapidly at the Omega hydraulic mine, near Washington, Nevada County, where large-scale operations are scheduled during the winter. About 40 men are reported to be employed. Theodor Larsen, superintendent, is in charge of operations.

▶ The banks of Deer Creek from the Champion mine to Deer Creek Falls below Nevada City are said to be under option to the Penn Dredging Company for the possible installation of two dragline dredges handling 2,000 cu.yd. per day. Testing of the ground is in progress, with George Weaver in charge.

Nevada

Failure to Find New Ore Closes Tybo Mine

Nevada loses an important silver, lead, and zinc producer—Como Mines sells its mine and mill equipment in bankruptcy proceedings

▶ The Tybo zinc-lead-silver mine and 300-ton selective flotation mill of the Treadwell Yukon Company, Ltd., 60 miles northeast of Tonopah, have been closed down and the mill equipment will be sold, President Philip R. Bradley said in a recent report, unless present search results in finding another mine to which it can be moved. Failure to find ore of economic grade on deep levels pointed several months ago to early suspension, according to W. H. Blackburn, manager. A recent report by President Bradley, outlining Treadwell Yukon's reorganization plan, indicated that operations will be confined for the present to the company's Alaska properties.

▶ Discovery of gold in the cleavage planes of schist near a massive quartz vein has brought a typical stampede of locators to the head of Ryan Canyon, on the Gillis range in central Mineral County. Men working on claims owned by R. T. "Dick" Pledge, of Hawthorne, lately shipped some 26 oz. of gold, recovered in panning and taken in small slabs and lumps from the loosely shattered schist. Adjoining claims have been acquired under option by the Champion Mining Company, for which Captain W. M. Awbrey, Reno National Bank Building, Reno, is fiscal agent and manager.

▶ The old Richmond shaft in the Ruby Hill area, near Eureka, has been reconditioned by the Eureka Corporation to the 200-ft level. An ore bin, a trestle, and track have been provided for shipping ore to a Utah smelter. Low-grade lead-silver ore is being trucked from the lava-bed workings to Lane City for rail shipment to the McGill smelter of the Nevada Consolidated Copper Company. Thayer Lindsley, vice-president and consulting engineer, has been at Eureka from his Toronto office.

▶ Acting by authority of Judge F. H. Norcross of the Federal District Court, Dryden Kuser, trustee in bankruptcy for the Como Mines Company, has sold mill and mine equipment of the bankrupt corporation for $44,000 cash to A. N. Sweet, an engineer acting for the Prescott Lease, at Silver Peak, Esmeraldo County, the name under which E. L. Cord, automobile manufacturer, and associates are operating the property under lease and option. The equipment has been brought to a prepared millsite at the portal of a new deep-level tunnel, designed to cut the Mary mine orebodies some 400 ft. below the deepest present workings. Under the Como reorganization plan authorized, service and supply creditors will be paid cash in full and after payment of bankruptcy costs the note creditors will receive 5 per cent of claims in cash, leaving some

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$5,000 in the treasury of the new company, which is to have 3,000,000 shares of $1 par value and retain the present corporate name. New directors, to be elected soon, may decide to continue operating the mine and provide a cyanide mill, since the oxidized ore does not respond economically to flotation.

▶An all-sliming cyanide plant has replaced flotation in the 100-ton mill of the Ohio Mines Corporation at Goldpoint, known formerly as Hornsilver, 30 miles south of Goldfield. Offices are in Cincinnati and Otto Dieckman, Jr., is manager at Goldpoint.

▶Plans to explore upper horizons of the Seg. Belcher and Belcher mines are being considered by officers of the Comstock Tunnel & Drainage Company. Covering 1,700 ft. of the lode, the two adjoining mines lie between the Crown Point at the north and the Overman mine of the Consolidated Chollar, Gould & Savage Mining Company, in which an orebody of great magnitude has been developed to a point within 100 ft. of the Seg. Belcher line.

▶Treating 40 to 45 tons per day, the mill at the Jumbo gold mine, in the Awakening district, Humboldt County, will continue on this basis during the winter months. Development is progressing in several tunnels with a force of some 30 men under direction of William H. McCartney, with office at Winnemucca.

▶A custom mill completed lately at Westgate, Churchill County, by the Westgate Mining & Milling Company, is equipped with a 125-hp. Caterpillar diesel power plant and generator, 40-ton **Eimco ball mill, Pan-American jig,** classifier, two 14-ft. amalgamating plates, and a six-cell Fahrenwald flotation unit. In February a 60-ton all-sliming cyanide plant will be added. E. S. Montgomery, 542 Lander St., Reno, is manager.

▶Camp buildings have been completed and county road crews have constructed a new road to the Four-mile Canyon mine, in the Cortez range, 25 miles south of Beowawe, in Eureka County. The property is held under option of F. H. Van Valkenberg and B. A. Asner, of Beowawe.

▶The Crystal group of eight claims near Box Canyon is being developed by H. Alex Johnson, Riverside Hotel, Reno.

▶Current enlargement of the mill of the Gold, Silver & Tungsten, Inc., at its Nightingale scheelite mine, in Pershing County, will provide capacity of 300 tons per day. John G. Clark, president, has been at the property from his office in Boulder, Colo.

▶Properties at Jarbidge, northern Elko County, operated in recent years by the Elkoro Mines Operating Company and formerly by the Elkoro Mines Company, are said to have been acquired by the Newmont Mining Corporation, following the recent shutdown of the mines and 150-ton cyanide mill.

▶Production has been increased at the property of the Tungsten Mines, Inc., in White Pine County, by the installation of a 135-hp. diesel engine. The company has purchased a flotation machine to augment its milling equipment. Four small lots of concentrate carrying 30 per cent tungsten trioxide have been shipped to Salt Lake City.

Idaho

Gold and Silver Producers Speed Operations

Development and shaft-sinking programs continue and silver output is increasing—Polaris Mines Company pays first dividend

▶Sierra Gaston Gold Mining Company, a Delaware corporation, has completed negotiations for obtaining 120 claims in the Sunset Peak district. The transaction includes the former Senator Clark group, owned by Anaconda Copper; the Ray Jefferson group, owned by the Day interests, of Wallace, and other smaller groups. A 400-ton mill on the Ray Jefferson will be remodeled under direction of W. L. Zeigler, Hecla mill superintendent. Earl Bowen is president of the new company, with W. Rogers Wade, of New York, as executive vice-president and Albert Burch, of San Francisco, as consulting engineer.

▶Bear Top mine, in the Murray district, owned by the Merger Mines Corporation, will soon start shipments to the Bunker Hill smelter at Kellogg, according to Manager Morris Pearson, of Murray. A crew of 25 men has been employed during the summer in reopening the lower tunnel and driving a 220-ft. raise. The lead-silver vein is between 4 and 6 ft. in width. Two miles of new road to connect with the main highway were recently completed.

▶The Fourth of July Canyon district, west of Kellogg, is active, with mine development at three properties. The Crystal Springs Mining Company, in the Wall Peak area, reports finding ore in the upper tunnel. Heavier machinery and equipment for increased operations will be brought in soon. L. G. Evans, of Rose Lake, is president of the company. King Solomon Mining Company is driving a crosscut to reach a downward extension of ore found in the upper workings. Jean Peters, of Osburn, is manager. King Tut Mining Company will start development work soon under the direction of James Gillette, of Kellogg. A camp is under construction.

▶Hailey, Idaho, reports that a rich vein has been discovered almost in the town itself by William Belanger, Ira Hartman, John Reddington, John I. Archison, and James Done, all Hailey miners. Telluride ore is reported found on the property, which has been located under the claim names of Hailey and Silver Mask. The vein is reported to be about 10 ft. wide, and small pockets of native silver are said to have been found.

▶One of the largest bodies of commercial ore in the Boise basin, 50 miles north of Boise, is being blocked out by the Grimes-Homestake company in veins recently cut by its 350-ft. Homestake tunnel. A drift is now following a vein 10 ft. wide containing gold, silver, copper, lead, and zinc. Assays taken across 9 ft. of the vein are said to give an average value of $33.60 per ton.

▶Metropolitan Mines Corporation, in the Big Creek district, reports the shaft collared for the proposed sinking from the 400 to the 600-ft. level. R. S. Merriam, of Wallace, is manager.

▶Polaris Mining Company, Coeur d'Alene's newest producer, entered the dividend class a few months after the first concentrates were produced by the company. The initial dividend will be for $60,000, paying at the rate of 3c. per share on issued capital of 2,000,000 shares. Payment was made Nov. 29. The Polaris has been under development for the last four years, with more than $600,000 expended in preparing the mine for production and in the erection of a modern milling plant capable of handling 200 tons ore daily. James F. McCarthy, of Wallace, is president of the corporation, with L. E. Hanley, Leo J. Hoban, Bert Woolridge, Wallace, and A. W. Witherspoon, Spokane, directors.

▶Palisade Mining Company, in the Mount Baldy district of the Coeur d'Alenes, has purchased a new compressor and power equipment to increase operations. Development is confined to a vein containing silver, copper, and gold. Manager Theodore Schmidt, Coeur d'Alene, reports two feet of snow at the mine, which is at an altitude of about 6,000 ft.

▶Two new gold strikes have been made in the Carson district of Owyhee County, according to E. R. Clark, of Nampa, secretary of the Mother Lode Company. According to Mr. Clark, two greenhorns from Oregon are now shipping ore said to be valued at $180 a ton, taken from ground turned down by old-time prospectors. The other strike was 5 miles north of De Lamar, where Frank Johnson and Bryan Brunzell have opened a new ledge, samples from which are reported to assay $12.50 a ton on the surface.

▶Gibbonsville Mining & Exploration Company, at Gibbonsville, is now shipping ore from its open pit to the East Helena, Mont., smelter, according to Walter C. Clark, of Kellogg, manager.

▶Fifteen men are now employed at the Mineral Point property of the Coeur d'Alene Mines Corporation in the Osburn silver belt. The shaft is being sunk on a two-shift basis with 125 ft. per month set as a goal by Joe Grismer, contractor. The shaft is designed to go down 1,000 ft., according to D. E. Watson, of Wallace, secretary.

▶J. W. Gwinn, of Boise, secretary of the Idaho Mining Association, reports that during 1936 labor in Idaho mines increased 34.6 per cent over the previous year. Man-shifts employed increased 34.8, and reported production for the entire state exceeded the expenditures by $1,148,794. During the year Idaho mines yielded $25,399,073.38 in metals of

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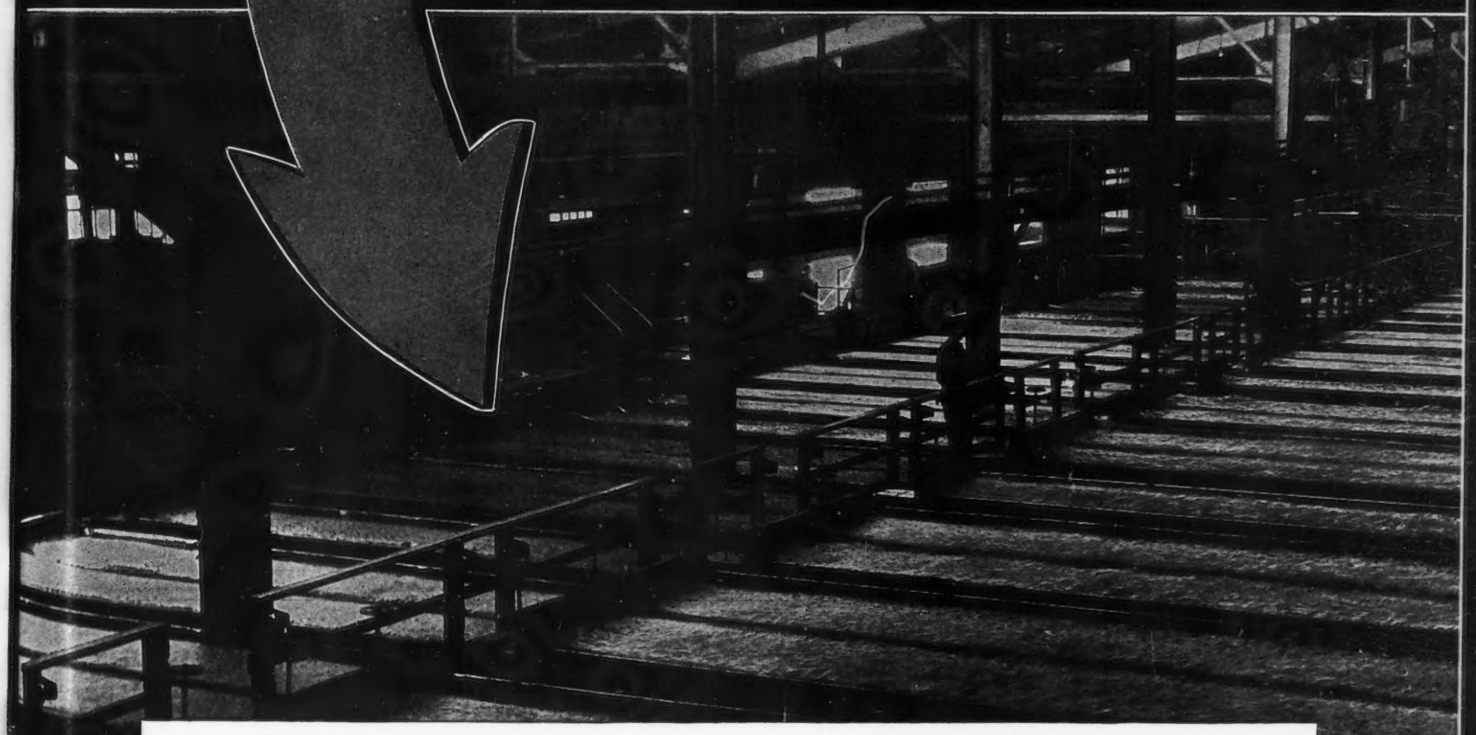

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▶IDAHO

all kinds. Freight and smelter treatment reached a total of $6,560,433.89. Federal taxes took $993,513.79, and State and county taxes totaled $989,793.61. Of the total man-shifts during the year, which amounted to 1,305,082, Shoshone County used 998,663 and produced $22,225,894 of the State's total of $25,399,073. For electric power the Coeur d'Alene district alone paid out $858,681.19.

Montana

Callahan Zinc-Lead Co. Enters Rimini District

Obtains lease on General Mines, Inc.—Trout Mining Company will erect new manganese mill—Break in shaft sets suspends hoisting through Leonard shaft at Anaconda

▶The Callahan Zinc-Lead Company, operating the Callahan-Interstate properties at Wallace, Idaho, has leased the properties of the General Mines, Inc., at Rimini, and has commenced reconditioning the plant preparatory to production of the complex lead-silver-gold ores of the mine. Frank Eichelberger, who has been actively associated with the recent developments at the Sunshine Mine, of Wallace, Idaho, is vice-president and general manager of the Callahan company.

▶Steel shaft sets in the Leonard mine of Anaconda Copper Mining Company broke recently, forcing a suspension of hoisting operations at the mine. As soon as the specially fabricated steel can be delivered repairs will begin. It is estimated that operations may be resumed in 60 to 90 days. A second 25¢ reduction in salary and wage scale became effective late in November, which placed miners' minimum pay at $5.25 a day, affecting about 12,000 employees.

▶Pending the construction of a new manganese mill, the Trout Mining Division of the American Machine & Metals Company has entered into an agreement with the Moorlight Mining Company to treat Trout manganese ores in the plant of the latter company. Charles A. Hyder is managing the Trout operation, which employs approximately 200 men.

▶According to a recent report, the Spring Hill gold-mining operation yielded in October $19,729 gross after smelting and marketing charges. After all charges are deducted, a net profit of $2,522 is credited against an accrued operating loss for the year amounting to $11,243. According to Gust Carlson, vice-president and manager, a constantly rising cost in supplies and a doubling of taxes as compared with 1935 are strongly reflected in the balance sheet. In addition to development of the Spring Hill mine, the company has largely financed the explorations under way in the Carlson mine, in which important developments in the near future are predicted.

▶A statement by W. S. Norman, president of the Butte Highland mine, south of Butte, Mont., says that the results of the first ten-day run of the new 100-ton cyanide plant indicate recoveries of 93 to 94 per cent. The estimated value of the bar of bullion shipped from this run is $7,500, which, in view of conditions usually met in a first run, is held to be satisfactory by the management.

▶A plan has been announced by the Montana Silver Mining Company under which the present 75-ton flotation plant will be increased to approximately 125-ton capacity. Under the management of Joseph Lancaster, the company operates a large acreage in the Neihart district which includes among others the Silver Queen, Big Seven, Aurora, and Coney groups. Production is mainly silver, and operating costs covering mining and milling are reported at about $4 per ton.

▶A new diesel-driven Sullivan 2-stage angle-compound compresser has recently been installed at the property of the Commonwealth Lead Mining Company, near Melrose. Also, a new lower-level development program is reported to be in progress. This latter is designed not only for exploration, but will greatly facilitate operating conditions at the property.

▶A small force of men has been engaged on the High-Up mine, near Virginia City, for the past two months under the direction of J. C. Gibson, local manager for S. F. Mallette and Walter K. Mallette, of Spokane, Wash., owners of the property. A carload of ore was recently shipped and will be followed by other shipments as rapidly as the mine workings are reopened and repaired. The mine is a gold-silver producer said to have extensive development.

Michigan

Rehabilitation Continues At Isle Royal Mine

Unwatering has reached below No. 5 and 6 shafts—Calumet & Hecla determining merits of an encouraging copper prospect

▶At Isle Royale, which is being dewatered and rehabilitated preparatory to resumption of operations, the water is down to the 22d level of No. 4 shaft, below the bottom of No. 6; and No. 5 shaft, which will be mined with No. 4, is being retimbered. Good progress is being made in pumping, as the mine openings are getting shorter with depth. Some minor repairs remain to be done in the stamp mill, which is being reconditioned.

▶Calumet & Hecla's most interesting exploration at present is on the St. Louis property, where a good showing in copper is reported. This work, however, has not proceeded far enough to determine either the permanence or uniformity of the copper deposit. There is encouragement in the present showing, and the exploration will be pushed.

▶For the past six months, the Quincy copper mine has been producing the highest yield of copper per ton of rock treated in many years. Ore from both operating shafts, Nos. 6 and 8, is uniformly good. Quincy is following the normal retreating system of mining, and openings are well in advance, and the stamp mill is operating.

▶Action designed to bring to a close the six-year-old receivership of the insolvent Seneca Copper Mining Company, was taken in Federal court in Marquette, Mich., at a recent session. After hearing considerable testimony, Judge Fred M. Raymond took under advisement a request that an upset price of no less than $2,000,000 be placed on the property if it is offered for sale.

▶A new record for safety in Michigan copper mines was established recently by a group of 30 men employed under the supervision of John Marta, shaft boss at No. 7 Hecla shaft of the Calumet & Hecla Consolidated Copper Company. The 30 men have worked three years without a compensable accident, and during that time have put in a quarter of a million man-hours. They completed the three-year record on Aug. 27. The work of these men takes them underground every day.

Iron Country

Stripping Programs Under Way on Reduced Basis

Employment will be maintained as much as possible during the winter months—Present forecasts for 1938 ore shipments much below 1937 record

▶Iron-ore shipments were practically completed by the first of December. The Wisconsin Steel Company was expected to be the last shipper this season, as the Hanna company and the Cleveland-Cliffs Iron Company loaded their last cargoes late in November. It has been necessary to steam frozen ore for the last few cargoes, due to low temperature. The season's shipments will apparently be about 62,000,000 tons, and observers believe if the business recession had not occurred, shipment this season would probably have broken all previous records.

▶No labor trouble has been experienced at the mines, and with seasonal lay-offs approaching, attempts will be made to give as much work as possible during the winter months. Unless some unforeseen great revival in the steel industry should occur, current forecasts for 1938 shipments are now running between 40,000,000 and 50,000,000 tons.

▶The low rate of steel production and

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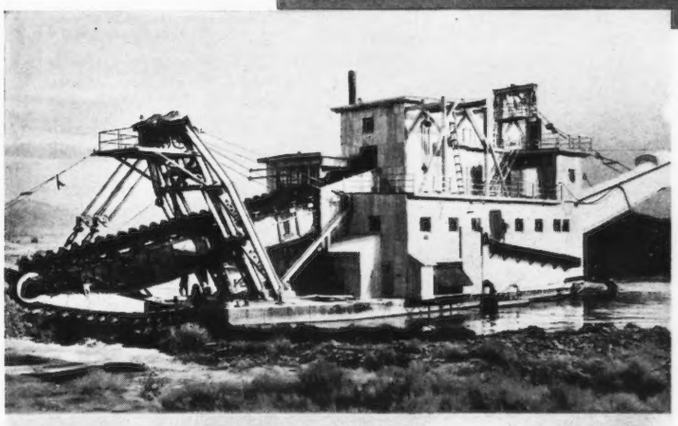

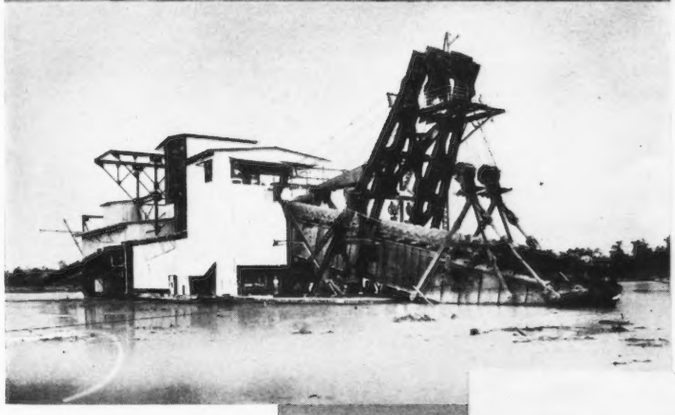

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▶IRON COUNTRY

the general business recession have reduced several stripping projects and curtailed expenditures to a minimum, but no reduction has been made in the price of labor.

▶ Pickands, Mather & Company are stripping at the Scranton mine, in Hibbing, Minn. This mine shipped close to a million tons this season.

▶ The Oliver Iron Mining Company is maintaining stripping operations at various mines along the range. Work is on a five-day basis, pro-rating labor so that as many employees as possible may secure employment.

▶ The Canisteo mine and the Hill Trumbull mine of the Mesaba-Cliffs Mining Company continued stripping in November. The Canisteo mine has completed the fall schedule and the Hill-Trumbull completed production about Dec. 1. The Canisteo is located at Coleraine, Minn., and the Hill Trumbull at Marble.

Tri-State

Tailing Plants Being Changed to Treat Ore

Some properties suspend operations following little demand for concentrates—Deepest shaft in district being sunk by Eagle-Picher Mining & Smelting Company

▶ The Hocker mill of the Velie Mines Corporation has completed re-treating tailings and has been changed over and is now treating mine ore, according to J. D. Velie, who is in charge of operations.

▶ The St. Louis Smelting & Refining Company has completed underground development and the erection of derricks and hoppers over three field shafts on three tracts of land adjoining its Ballard (No. 8) mill. These shafts are on three separate fees, and sampling equipment has been added to the mill to allocate properly the concentrates produced. The Ballard mill will operate on two eight-hour shifts to take care of the added tonnage from these shafts, according to H. H. Utley, district superintendent.

▶ Garrett shaft of the Eagle-Picher Mining & Smelting Company was down 300 ft. the middle of November. The shaft, which is to be sunk to a depth of 450 ft., will be the deepest shaft in the district. Joe Hutts, Sr., has the contract for shaft sinking.

▶ The Brewster tailings re-treatment mill of the Bilharz Mining Company shut down early in November with the exhaustion of the tailings pile on the Brewster lease. The mill will be changed over to handle mine ore. A new six-cell rougher jig will be installed and the present split jig will be revamped for use as a cleaner jig. A Butchart flotation machine and a concentrating table will be installed in the lead circuit. Pumping operations have been started in the old field shaft in the southwest part of the lease.

▶ C. F. Dike, manager of the Interstate Zinc & Lead Company, reports his company is drilling a 15-in. churn-drill hole to a depth of 335 ft. on the Cherokee lease just north of Treece, Kan. A 10-in. Peerless turbine pump will be installed in the drill hole to lower the water, which now stands at 290 ft. The east field shaft will be sunk 70 ft. to the 335-ft. level. The company is also reopening an old shaft on the Cardin Townsite lease which was sunk about twenty years ago. The shaft, which is 200 ft. deep, will be cleaned out and re-cribbed. This tract is unusual, in that it is made up of a group of small town lots.

▶ The Gordon (central) mill of the Federal Mining & Smelting Company was placed in operation the middle of November. This mill will treat ore from eleven shafts scattered throughout the Picher and adjacent parts of the Tri-State district. L. G. Johnson is district manager for the company.

▶ The Chubb mill of the Commerce Mining & Royalty Company finished the re-treatment of tailings from the Kansouri lease the later part of October. Some work was done preparatory to reopening the mine, but the rapidly decreasing demand for district concentrates has postponed plans for immediate reopening of the mine. John A. Robinson is manager for the company.

▶ Evans-Wallower Lead Company has been reorganized under the name of the Evans-Wallower Zinc, Inc. The reorganization took place at an adjourned special meeting Oct. 11, 1937. Announcement of the reorganization was made by F. S. Elfred, Jr., of Baxter Springs, Kan., company president.

▶ Seventeen concentrating plants have ceased operations since the end of September due to light demand for concentrates and it is rumored that other plants may soon shut down.

"Foreign Minerals Quarterly"

UNDER THIS TITLE the Bureau of Mines is to issue four times a year comprehensive regional reviews of the production, consumption, and trade in minerals. The "Quarterly" will supplement the present monthly "Mineral Trade Notes." It will give similar information, but each issue will be devoted to one or two special areas of current importance, summarizing all information that the Bureau staff has been able to bring together with the assistance of the consular officers abroad. Where possible a complete statistical presentation based on official figures will be included; but where official data are not available the best trade and technical sources will be utilized.

Those desiring to receive the "Quarterly" will be placed on the Bureau mailing list without charge. The first issue will appear in January, 1938.

Utah

Size of Elton Tunnel Reduced in Cross-Section

Dimensions beginning at 4,500 ft. from portal will be 8x8 ft. instead of 12x12 ft. —Lower metal prices bring wage reduction to many miners

▶ Operations were resumed on Nov. 16 at the Elton Tunnel of the National Tunnel & Mines Company, Tooele, after a shutdown since Oct. 22. The size of the tunnel was reduced by approximately one-half, according to J. O. Elton, vice-president and general manager, Kearns Building, Salt Lake City, in order to lower the cost of construction. At a point about 4,500 ft. from the portal, the 12x12 ft. cross-section was cut to 8x8 ft. Dimensions of the concrete water ditch are 3x2½ ft. as compared with 3x4 ft. This is deemed sufficient to carry the expected flow of 15 to 20 second-feet of water, since the ditch will have a grade of 17 ft. to the mile. Engineers believe that the small size of the tunnel will not greatly affect its usefulness. It will form an economical entry for draining and prospecting at great depth the lower horizons of the Utah Apex and Utah-Delaware mines, in the Upper Bingham district, as well as virgin territory. If found to be inadequate for the transportation of large tonnages, it can be enlarged. Only one mechanical mucker will be used. About 80 workers were laid off when tunnel operations shut down. Thirty-five men were reemployed, preference being given to married men. When completed, the tunnel will be 23,000 ft. long. Starting nearly a mile north and west of the Tooele smelter and flotation plant of the International Smelting Company, it is pointed southeast to connect with the 2,500 level of Utah-Delaware workings.

▶ Directors of the Park Utah Consolidated Mines Company have declared a dividend of 15c. a share, payable Dec. 20. Total amount of the dividend is $313,725, according to O. N. Friendly, vice-president and general manager, Continental Bank Building, Salt Lake City.

▶ A course in prospecting and mining is being given under a cooperative agreement by the University of Utah Extension Division and the vocational department of the State Department of Public Instruction. The curriculum will consist of lectures, field work, and the practical operation of a mine. Frank H. Gunnell, consulting geologist, State Tax Commission, Capitol Building, Salt Lake City, is in charge. Lectures and classroom work are being given at Park City, Tooele, Midvale, Ogden, Provo, Eureka, and Salt Lake City.

▶ Three leases are being operated in the Yankee Mine of the American Smelting & Refining Company, Mary Ellen Gulch, American Fork district, 50 miles southeast of Salt Lake City. L. B. Birch and Willard Cleghorn are each working separate blocks of ground under a lease.

(*Continued on page* 76)

UTAH

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New electrically operated feeders provide positive control of the rate of feed at all times. The amplitude of vibration is readily changed over a wide range ... by simple manual adjustment of a hand wheel. Utah feeders handle both large material and fine. Dual magnets give positive action in both directions.

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NEWS FROM Washington

By Special Correspondent

UNCERTAINTY is the only word which describes the attitude of the members of Congress as they have resumed their legislative tasks during November. This uncertainty relates to what they should do, what they want to do, and what they will be forced to do as they consider the bills which the Administration presents for major legislative action. And the outcome cannot be forecast even by the wisest.

The "business recession," which the Administration refuses to call a depression, has definitely alienated many Congressmen from their rubber-stamp habit. If this business difficulty continues the members of Congress know that the President's standing and influence are sure to decline. They, therefore, want some important evidence of independence in action to cite to their constituents when election time comes next year.

Under prevailing conditions speed in the enactment of any legislation should not be expected. Some even forecast that no measure of importance will be passed during the special session. But even that would not mean a waste of all the time, since many agreements for later voting will have been reached.

Mineral Sanctions

USE OF MINERAL SANCTIONS as a means of international military control is being studied in Washington. The general idea is that withholding of raw material supplies from a would-be aggressor might suffice to prevent aggression. Both the military and technical authorities studying procedures recognize, however, that no successful technique has yet been developed.

Some of the civilian officials are disposed to liken sanctions to jiu jitsu. Pressure on the other fellow is very successful in making him manageable, if you press just hard enough on just the right spot. The difficulty seems to be to find the right spot and then to apply just sufficient pressure on these mineral commodities.

The failure of sanctions in the Italo-Ethiopian incident is blamed by Washington observers on the inadequacy of planning and the fact that full cooperation of all significant interests was not arranged. Curtailing supplies of aluminum for Italy is characterized as silly, when Italy is quite self-sufficient with respect to that light metal. And the breakdown of petroleum control in another case "was inevitable," since Rumanian oil supply was not cut off. For any particular situation, these critics explain, it is essential to pick the right metals and to be sure of complete cooperation of all suppliers.

But even this complete cooperation is only a theoretical success, it is feared. For example, the Government and commercial groups interested in tin can get together quite readily, just to use one example. But bootlegging of tin into the forbidden areas might still follow, unless an effective tin blockade, supported by naval force, were available.

Tentatively, Washington concludes from its major studies that only by cordial British and American cooperation, with both governments and industry participation, would it be possible to do much with mineral sanctions; and even then it must be assumed that the combined strength of British and American navies is available to inspire, if need be compel, observance of orders.

That the War Industries Board was a useful agency during the World War is explained by the fact that these were practical men, who knew the real and potential channels of trade, so that their actions could have the force and scope of really effective regulations. As yet there is no proposal for such a new agency of British-American cooperation.

MEXICO TAKES MINERALS

ACTING UNDER an old law the President of Mexico has recently taken possession of several mineral properties formerly held by enterprises of American ownership. At the start the Mexican courts have refused to review the executive action on the ground that the President has such emergency authority. The companies aggrieved deny this, claiming that there was no retroactive feature to the law that would authorize such action. These recent seizures are explained by the Mexican Secretary for Foreign Affairs as a part of the policy of "the reconquest of Mexico for Mexicans." The particular cases of recent date relate to petroleum, but it would not be unexpected if similar action were taken with respect to metalliferous ores and non-metallic minerals. It is expected that government support will also be given to those labor leaders who demand more favorable wage and salary rates in strike settlements.

THE STATE DEPARTMENT has instructed the American Ambassador at Mexico City to make unusually forceful representations to President Cardenas. There seems to be no doubt as to the seriousness with which Secretary Hull's staff views the situation. Some of the language said to have been employed "does not sound diplomatic to a layman." The unsettled condition of Mexican affairs and the recent change in government of Brazil to a quasi-totalitarian form, indicate that the Good Neighbor policy is facing serious difficulties.

Metal Tariffs

ANNOUNCEMENT of further negotiations of reciprocal trade agreements has disturbed spokesmen in Washington of the metal and mineral industries. Special concern has been expressed regarding the intention to develop pacts with Norway and Great Britain and to revise the Canadian agreement. "Observers see a possible danger to the present duties on lead, zinc, copper, and possibly other metal and mineral products." And "Canada in particular is a potentially large supplier of lead, zinc, copper, and other mineral products."

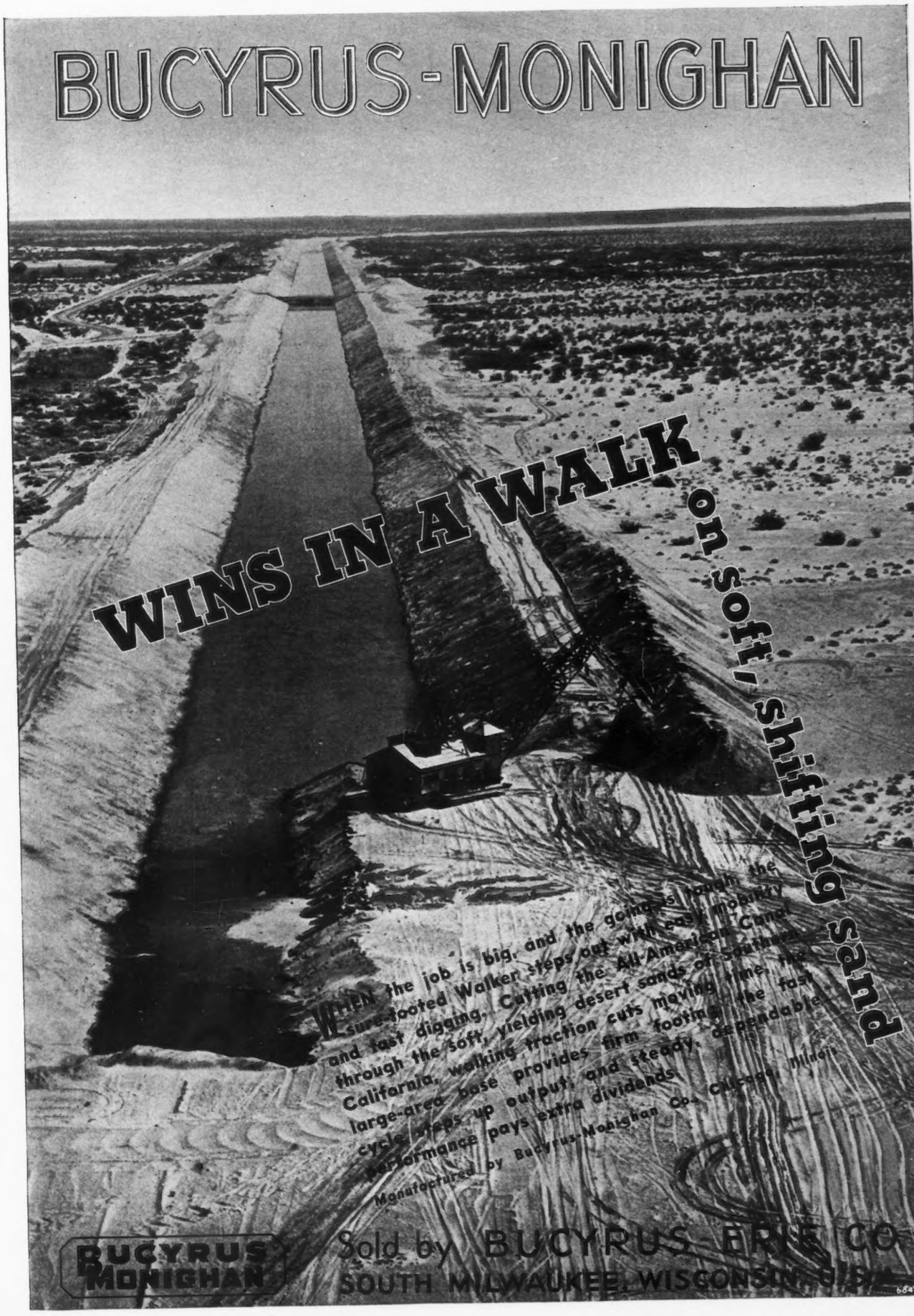
Under the new procedure of the State Department in these trade studies, there is announced at the appropriate stage a list of the commodities on which tariff changes will be considered by the Department. At that time the American mining industries can know definitely which of their products are under consideration. The State Department assures the mining industries that no commodities not on such list will receive study for tariff cuts unless notice is given and opportunity for hearing afforded.

There is no doubt that a much more fundamental consideration of international relations in deficiency minerals will be taken into account when the British and Canadian projects are under study. Presentation of arguments on points of this character will, therefore, be appropriate at any time.

Smelter Tribunal

CONTINUING STUDIES of the international smelter smoke Tribunal demonstrate the fundamental differences in policy between the agricultural interests seeking damages, and the metallurgical interests seeking protection against the complaints of "smoke farmers." Most of the agricultural complaints are based on the charge that sulphur damage is serious. Apparently little attention is being given by the farmers' spokesmen to the potential damage of metal fumes. To have done so, metallurgists claim, would have been to admit that insecticides containing lead, arsenic, and copper may be detrimental to the soil even when currently helpful in pest control.

One comment on the situation which now affects only Trail, British Columbia, shows the sweeping possible significance of this case. If United States farmers secure damages from Trail, so the story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goes, there will be a splendid basis for extensive claims from Mexican farm areas against United States operators in the Southwestern states. For this reason American spokesmen before the Tribunal are not as enthusiastic in their claims for damages from Canada as they might otherwise be.

New Tin Policy?

THE HARDY PERENNIAL idea that the United States must have its own tin-smelting industry is expected to bloom under the stimulus of Congressional hot air this winter. Apparently the same group which had formerly fostered this idea is going to propose again a tin tariff and a Federal subsidy for tin smelters in the United States. Of course, exploration of everybody's alleged tin resources will be promised, whether these be in the Carolinas, the Dakotas, or elsewhere that votes grow and tin has once been found, even in non-commercial quantities.

Critics of this scheme make a constructive counter-proposition. They argue that half as much Federal subsidy for research on tin substitutes and economy in tin utilization would do the American people far more good.

During recent years the world price of tin has apparently been sustained in significant measure by growing use of tin containers for things like beer, lubricating oil, and other petroleum products. Washington wonders whether the American people are going to pay indefinitely the prevailing prices for tin, simply to have a good-looking oil can at the filling station. The broader and more important question is, where, if a tin subsidy is established, will this Federal policy stop. Why not similar subsidies for other metals and minerals?

More Reclamation

MINING INDUSTRY of the West can count on enthusiastic continuation of the Federal reclamation policy, if the President can have his way. This means more possible power developments in the mining states, where subsidies from Washington build both a foundation for dams and for political recognition.

Two sharply conflicting land policies confront the Administration. Agricultural surpluses demand a curtailment of the land under cultivation. Reclamation and irrigation demand that more land be tilled and more prolific land be provided for farmers.

John C. Page, Commissioner of Reclamation, in an address not long ago undertook to explain why reclamation should go forward, despite the need for curtailed production of the major agricultural crops. His defense was:

"There has never been too much land under cultivation in these Western states. There has always been a crying need for more, just as there is at this time when tens of thousands must go homeless. These states are limited in their agriculture by meager natural waters. Irrigation is essential here if farming is to be practiced at all. These Western irrigated lands do not add to surpluses of the great staple crops. Last year the Federal reclamation projects produced only one-tenth of 1 per cent of the total corn crop of the United States; only seven-tenths of 1 per cent of the total wheat crop; only 1.4 per cent of the total cotton crop, and no tobacco at all. Their production of corn, wheat, and cotton was insufficient to supply their own needs, and much was imported to them from areas where these crops dominate."

All of this reclamation policy does affect mining, because it ties in with the New Deal planning program, which continues to press vigorously the idea of seven regional boards, each to plan for the development of resources, for land utilization, and for water control throughout their respective areas. The President says that these are not going to be seven more TVA's. The distinction seems to be that they will go much farther than TVA has, particularly in the control of mineral resources. Usually capable forecasters of legislative progress appear about equally divided in their opinion as to whether or not Congress will ignore state lines in order to create these seven regional boards. But whether they are created or not, it may confidently be expected that some further aggressive planning for mineral policy will be undertaken. Under these circumstances it becomes increasingly important for mining executives to consider the following in the President's message on Nov. 15: "To avoid waste and to give the nation its money's worth from the national funds we expend, we must, like any business corporation, have a definite building and operating plan worked out ahead of time . . ."

TAX LAW CHANGES

MEMBERS OF CONGRESS struggling with questions of tax-law revision are torn by two conflicting desires. Most of them sincerely believe that some lightening of business taxes would help restore confidence, turn the tide of business activity, increase employment, and be otherwise helpful. They would like to support such measures, specifically, revisions in the undistributed profit tax, and the capital-gains tax.

BUT TO DO THIS threatens to reduce the Treasury income. This would mean further unbalance of the budget, and most members of Congress realize that such a result might undo much of the good which tax alleviation would accomplish. Furthermore, each Congressman has a pressing demand back home for greater Federal spending in his own district. He, therefore, greatly dislikes to cut agricultural bonuses, curtail relief spending, or slacken pump priming. And yet only by such cuts is there hope of budget balance.

AS TAX LAW DEBATES proceed from now into the new year it is expected that the major deals between the White House and Congress will have to relate to these matters of curtailed spending, tax modification, and effort to get budget balance. Incidentally, the Administration at the beginning of the session is undoubtedly truly sincere in this latter effort. At no previous time have the President and the Treasury so valiantly and continuously pressed for economy as now. The truth of this will be clearly evident when the budget message is presented to Congress next month (January). But it is not at all sure that Congress will be willing to go along with the cuts that Secretary Morgenthau promises in road building, other public works, relief, and agricultural benefits. To cut back by $700,000,000 on these four items alone is not expected of Congress, though that is the avowed Treasury plan.

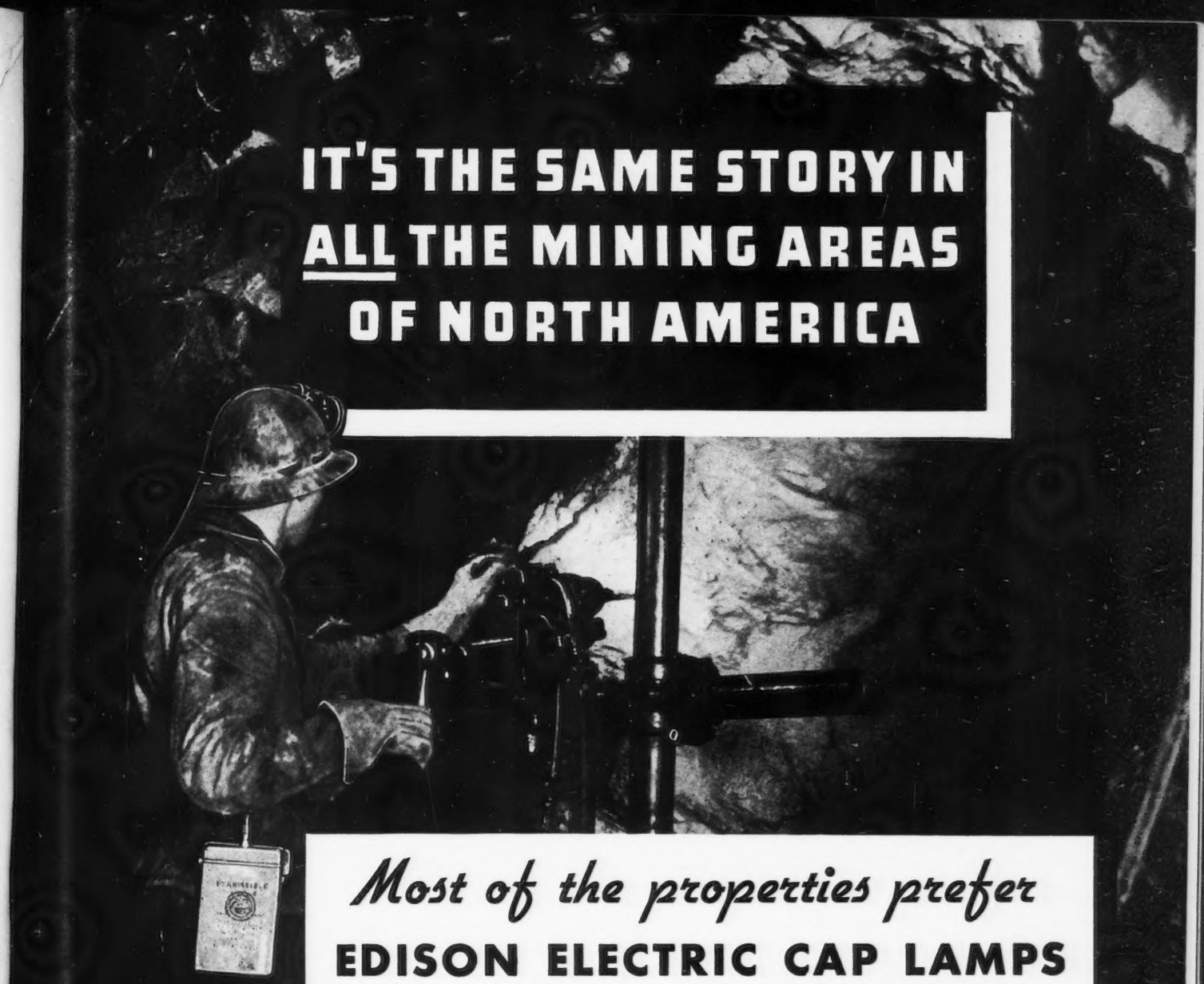
Fume Control

TWO METHODS of controlling dust and fumes from smelters are being aggressively investigated in the metallurgical division of the Bureau of Mines. Reporting on these activities on the occasion of the dedication of the new Eastern Experiment Station, C. W. Davis described both the work in the use of sound waves and a new technique not previously publicly described, using a chemical snowstorm.

By injecting suitable chemicals into smelter fume or dust, large flakes of chemicals are precipitated in a form that provides a snowstorm in the ducts. The large flakes not only include some of the objectionable gaseous products like sulphur dioxide, but also carry down with them most, if not all, of the suspended solid matter. Referring to this technique, Mr. Davis said: "The chemical snowstorm method of dust precipitation is particularly interesting in the case of smelter fume, because here we encounter large quantities of sulphur dioxide, the elimination of which is becoming more and more imperative. The best chemical snowstorm we know is formed by adding ammonia and steam to these sulphur dioxide containing fumes."

The reaction involved in this particular case is, of course, the simple combination of ammonia vapor and steam with the sulphur dioxide to form acid ammonium sulphite, NH_4HSO_3. This chemical can, after processing, subsequently be utilized for applications in which the ammonia is useful, fertlizer for example. Thus the sulphur disposal problem in fertilizer is simplified, not requiring the manufacture of phosphate. And in the processing of the original sulphite the contained metalloids like arsenic can be recovered, giving by-product values that may help pay the fume control bill.

Both this chemical snowstorm and the super-sonic dust control methods, using high frequency sound waves, are still in the small-scale experimental stages, but semi-works trials are to be made as soon as the Bureau can make suitable arrangements.



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▶UTAH

(*Continued from page 70*)

from S. A. Steir. Birch, Cleghorn, and Steir are mining a third block. Discovery of a new orebody last summer has changed the character of production. Formerly, the mine produced mainly from a copper-silver-gold deposit above the tunnel level. A substantial body of silver-lead-zinc ore has been opened up above the copper deposit. Production is averaging 800 tons a month—600 tons of lead-silver ore and 200 tons of copper-silver ore. The ore is shipped by aerial tramway to Deer Creek, 5 miles distant, where it is loaded on motor trucks and hauled to the Pleasant Grove railroad station.

▶ Utah mining and smelting companies paying a sliding scale of wages based on metal prices reduced their pay 25c. daily as of Nov. 1. Wages at Park City, Tintic, Bingham, Midvale, and Tooele were affected.

Arizona

Boriana Tungsten Mill Wrecked by Fire

Mine development was advancing to increase production of tungsten—Plant under lease to Molybdenum Corporation of America will be rebuilt—Copper production curtailed at Inspiration

▶ Fire broke out in the change room near the base of the mill of the Boriana Mining Company, near Yucca, on Nov. 18 and rapidly spread, wrecking the structure and damaging machinery. Definite plans for rebuilding have not been announced, but construction is expected to start after insurance adjustments have been made. The company has been pushing development work to increase production and has been building a new road to recent developments higher up in the Hualpai Mountains, to haul tungsten ore to the mill. Destruction of the mill, however, has forced complete suspension of operation, throwing more than 100 men out of work. Dave Rankin is resident manager.

▶ A curtailment in production of 50 per cent is now in effect at the mines of the Inspiration Consolidated Copper Company at Inspiration. Output, formerly on a basis of about 10,000,000 lb. per month, has been reduced to 5,000,000 lb. per month. Lack of demand for copper brought on by the present recession in business has forced officials of the company to take this action.

▶ The Gold Standard Mines, of Kingman, operating the Katherine mine and mill, are retimbering the main shaft, which was burned out over two years ago. The work has reached the 600 level. Retimbering has been slow because of caving ground which had to be caught up. About two months more is expected to be required before the 900 level will be reached and exploration started. Richard de Smet is general manager. The mill has been in constant operation for the past three years, with an average daily tonnage of 250 tons, treating ore from the Portland, Arabian, Philadelphia, and Thumb Buttes properties.

▶ The Julius group of mines near Quartzsite, recently taken over by B. F. Koch, of Cleveland, Ohio, and James Simpson of Phoenix, is planning construction of a mill on the property. There are approximately 2,000 ft. of mine workings, and a substantial tonnage of ore is said to be developed.

▶ The Western mine, at Oatman, has been obtained under bond and lease by the Dayton Consolidated Mines Company of Nevada. Exploration is being directed by A. J. Klamt, consulting engineer, of Virginia City, Nev. The mine consists of four claims owned by the Consolidated Gold Mines Company. Dan Harper is superintendent in charge of operations, and about 30 men are employed.

▶ The Molybdenum Gold Mining Company, operating the Mohawk and New Year mines, at Mammoth, is producing about 2,700 tons of molybdenum, gold, and vanadium ore monthly. B. K. Geib is mine superintendent. About 20 men are employed.

▶ The Seabord Mining Company, with offices at 146 West Adams St., Phoenix, has taken a lease and option on the Rio del Monte gold claims, about 4 miles south of Salome, in the Ellsworth mining district. The company is headed by O. K. Gilliam, 366 Bradbury Building, Los Angeles. Active development work of the property is planned by the new company.

▶ The Holmes Mining Company has resumed operations on its property at Courtland, under the direction of Theodore Reich. The main shaft is down 400 ft., with about 8,000 ft. of drifts. New machinery and other equipment is already on the property and is being installed.

▶ The J. C. Mining Company has been organized to operate the Davis mine, near Stanton. The mine is producing about 60 tons of gold-silver ore monthly, and increased production is planned. Henry Yoshiga, of Congress Junction, is directing the work.

▶ The Montana Mine Operations, a subsidiary of the Eagle-Picher Mining & Smelting Company, at Ruby, is maintaining a monthly production of 10,000 tons of silver-lead ores. The company has maintained this record for the past two years or more. Its flotation mill is operated on a 24-hour daily basis. Shipments total about 35 carloads of concentrates per month. At this time, 356 men are on the payroll. Grover J. Duff is superintendent.

▶ Property of the Orizaba Mining Company situated about 40 miles north of Glendale is being opened under the direction of Walter S. Larssen, superintendent.

▶ The Billy E mine, in the Palmetto district near Nogales, is following a program of development work on a gold-silver-lead vein that averages $26 per ton. About 100,000 tons of ore is reported blocked out above the tunnel level, and future plans include the sinking of a shaft to 500 ft. Max Ritterath, of 391 South Madison Ave., Pasedena, Calif., is directing operations.

▶ The Alexander and Fields lease on the Iron King mine, at Humboldt, is producing about 2,400 tons of ore per month, recovering gold, silver, and copper. About 40 men are employed on a two-shift basis. The property is owned by Fred Gibbs and is leased to John Alexander and Howard Fields.

▶ U. S. Mines, Inc., is operating a group of five claims near Skull Valley. A. L. Lampton, of Skull Valley, is president and general manager. The ore contains gold, silver, lead, and zinc, and about 1,200 tons is shipped monthly.

▶ American Boy mine of the Gross Mining & Investment Company, in Patagonia, is working a crew of men on development. The property contains copper ore and is opened by a tunnel 400 ft. long. Albert F. Gross, of Duluth, Minn., is president of the company. F. C. Gross, of Patagonia, is general superintendent.

Colorado

Georgetown District Continues Active

Mining companies operating in high altitudes plan work through winter months—Longer tunnel proposed near Dumont

▶ The Clear-Creek Gilpin tunnel, at Dumont, is to be extended, and the operators are considering plans for the erection of a new mill. The tunnel is now about 1,700 ft. long and may be extended to 10,000 ft. if present plans are followed.

▶ Olsen & Company, leasers, recently opened a rich pocket of ore on the twelfth level of the Golden Cycle mine, and shipped two cars of ore reported to average nearly 15 oz. of gold. Regular ore shipments average about an ounce of gold to the ton.

▶ The Tenderfoot Hill tunnel being driven by the Verner Z. Reed interests, of Denver, is nearing completion. This tunnel is being driven from the bottom of the Mollie Kathleen shaft.

▶ Steady production and development in the Georgetown area is reported from the following: The Minnesota Mines, at Empire, are producing about two hundred tons daily; the Cardigan group of mines, on the Gladstone vein, have made a good strike, the new vein being about 4 ft. wide. At the Freeland property, which is worked through the MacCleeland tunnel, two shifts are in operation in both mill and mine, which is producing gold, copper, and lead ore. Three shifts are operating the Phoenix mill. At the Kavern mine, near Dumont, crosscutting

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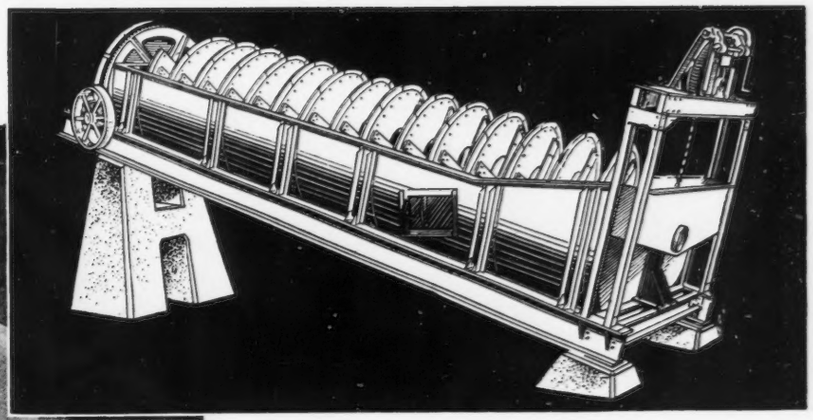

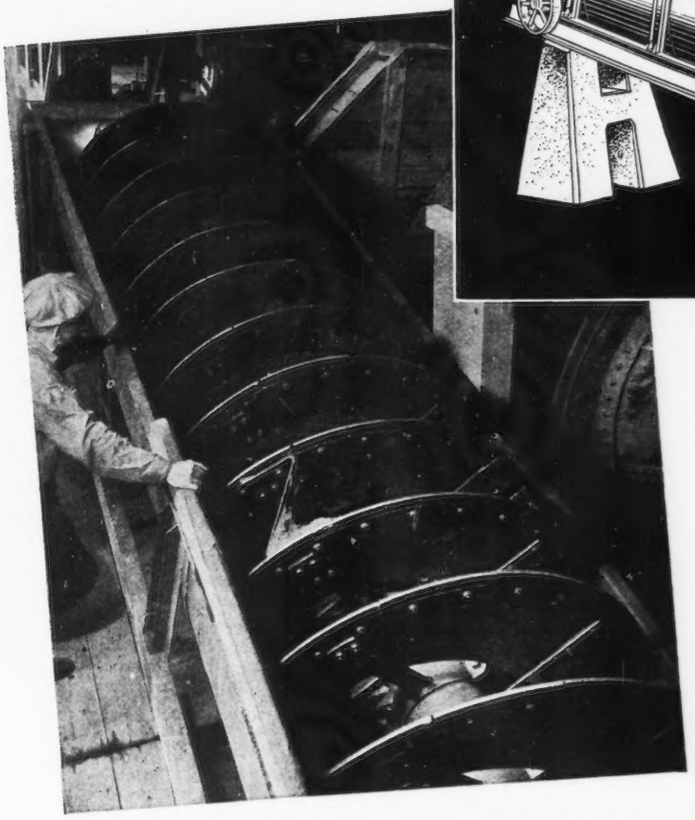

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▶COLORADO

is being maintained to cut the Kavern vein. Most of these properties plan operations throughout the winter months. Ore shipments from Clear Creek County during October are reported the largest in many years, totaling 119 cars. The Alice property of the American Smelting & Refining Company shipped between 500 and 600 tons of concentrates. This was the largest shipment from any property. It was followed by the Minnesota mines, at Empire, and then by the Alma-Lincoln mine.

Washington

Camp Buildings Almost Completed at Holden

Copper mine near Lake Chelan now developed by five levels—Metalline district continues active

▶ Construction and development at the copper mine operated by the Howe Sound Company at Holden, near Lake Chelan, is progressing at a satisfactory rate. The modern steel mill, of 1,000 tons' capacity is nearing completion, with crushers, ball mills, and several tanks installed. Foundations for the shops, warehouses, change room, offices and compressor building are completed and steel erection is under way. The permanent camp is almost completed and is considered to reflect the latest design in architectural planning. Four dormitories, each providing accommodations for 50 men, are equipped with modern conveniences. The mess hall will seat 264 men. The mine is developed by five levels, and ore to be sent to the mill is expected to average around 1 per cent copper. C. P. Browning is general manager and George C. Lipsey is general superintendent.

▶ Mine development continues at the Pend Oreille mines, near Metalline Falls, and the company plans to simplify ore transportation and reduce crushing costs by transferring the crushing equipment to a new plant nearing completion. Minor changes in crushing practice are also planned. Lewis P. Larsen is president and Charles A. R. Lambley is general manager.

▶ The American Zinc, Lead & Smelting Company, operating the property formerly held by Metalline Mining & Leasing, is actively developing the zinc deposits recently reached through a 4,800-ft. haulage tunnel and opened by about 650 ft. of raises and 250 ft. of crosscuts. The company is also continuing diamond drilling on the Grandview property, 4 miles from the Metalline mine, and has started initial operations of the Grandview mill that treats ore from the Metalline mine. Electric power for the mill is now being furnished from Pend Oreilles power plant. R. E. Calhoun is superintendent, Carl Martin mill superintendent, and H. F. Mills engineer and geologist.

▶ The Knob Hill mine, near Republic, is treating about 400 tons of gold ore daily in a well-designed mill of the counter-current type. Walter Lyman Browning, of San Francisco, heads the company, and F. L. Metter is general superintendent and C. L. Cooper is in charge of the mill.

▶ Eureka Mining & Milling Company is operating the old Quilp mine, south of Republic, treating about 85 tons daily in a reconditioned cyanide plant. George Kirkbride is president.

▶ Leasers in the Republic district have been mining siliceous gold ore and shipping to the A.S.&R. smelter at Tacoma. Small mines in the district have suspended operations during the winter months.

▶ Plans for a 70-ton mill are said to have been completed by the Ora-Tahoma Mining Company, F. G. Berto, president, Tacoma, for erection on the Queen mine, north of Benton, Mone County. The company acquired also the adjoining Poorman group of claims. Extensive underground development is planned.

Canada

Further Mine Taxation Not Expected in Quebec

Premier of Province desires to encourage mining industry — Consolidated Mining & Smelting Company raises wages

▶ With an estimated production value of $58,000,000 for the Quebec mineral industries in 1937, compared with $26,000,000 six years ago, mining has become a vital factor in the economic life of the Province and calls for a clearly defined Government policy. A dramatic first statement of such a policy was given on Nov. 22 when the Honorable Maurice Duplessis, Premier of Quebec, addressed a meeting of the Montreal Branch of the Canadian Institute of Mining and Metallurgy. Enthusiasm greeted the statement that no further taxation is to be imposed on the mineral industry, at least for several years, nor will any changes be made in the Quebec mining laws until all interested parties have been consulted. "The mining industry in this Province will be protected," the Premier declared. The Quebec Government will go into the power business in the mining districts and will assure a supply of electric power "at a generous price"; life-of-mine contracts involving unfair rates will be cancelled as soon as new hydro projects are available.

▶ Taking advantage of improved highways built by the Government to the Chibaugamau district, Obalski Mining Corporation plans a program of underground development. According to the president, J. R. Giroux, the 75-ft. shaft will be deepened to 300 ft. and three levels opened up. Consolidated Chibaugamau and other mines in the district have suspended operations pending construction of a railroad and a smelter.

▶ Present plans for expansion at Wendigo Gold Mines call for opening up four new levels below 500 ft. and carrying lateral development on the main shear zone to a length of approximately 2,000 ft. H. G. Young is vice-president and managing director.

▶ Buffalo Ankerite Gold Mines, in the Porcupine district, is making fast progress in sinking a new five-compartment shaft toward the objective of 3,000 ft. On completion of this sinking program it is expected that the production rate will be advanced beyond the present mill capacity of 1,000 tons, hauling ore raised through the North shaft.

▶ New ore developments at Kirkland Lake Gold Mines have had important results on the mine outlook. Ore grade has been improved to average with other operators in the Kirkland Lake camp and the 250-ton mill is showing efficient recovery and has more than a two-year ore supply developed and broken in stopes. Victor H. Emery is managing director.

▶ Preston East Dome Mines, one of the three important new developments in the Porcupine area to announce plans for large-scale mill construction next year, reports positive ore reserves of 265,000 tons above the 200-ft. level. Present policy is to install an initial mill unit of 500 tons' capacity employing flotation and cyanidation. Average ore grade down to the second level is estimated at $7 per ton across widths ranging from 20 to 50 ft., although development work has opened up sections that show better ore.

▶ John M. Forbes, consulting engineer, states that 45,000 tons of $11 ore have been indicated by Pandora Cadillac Gold Mines above the 500-ft. level in No. 1 shaft. The property is on the main break in Cadillac Township, between the Amm and the Pan-Canadian mines. Both neighbors are preparing for mill construction and Pandora has also demonstrated commercial possibilities, but, for the present, is concentrating on developing a substantial tonnage of ore before deciding on a production program.

▶ Jellicoe Consolidated Gold Mines, in the Little Long Lac district, has started three levels from its 536-ft. shaft at 225, 350, and 500 ft. Drifting on the 225 level is now under way toward an oreshoot determined by diamond drilling to be about 600 ft. long averaging $18.67 over a width of 4½ ft. M. A. Twidale is in charge of operations at the property, S. J. Kidder is consulting engineer, and W. A. Gordon is president.

British Columbia

▶ The production of base metals by the Consolidated Mining & Smelting Company this year has been considerably greater than in 1936. It is expected a new peak will be reached in lead output, which in the first nine months of the

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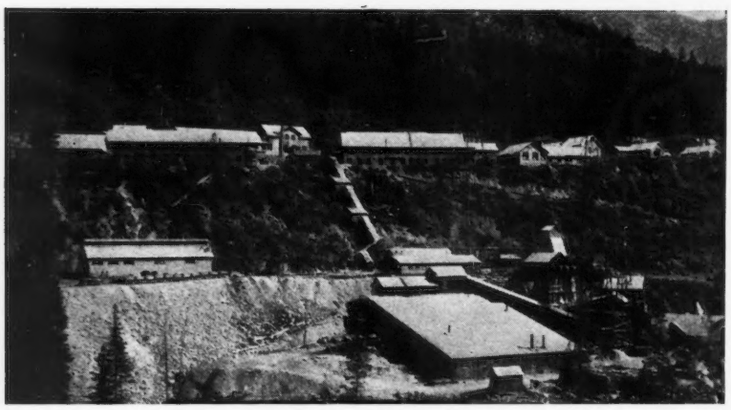

Bralorne Mines, Ltd., in British Columbia, recently stepped up mining operations, treating around 500 tons of gold ore in the enlarged mill in the foreground. Milling operations started in 1932 on a 100-ton per day basis

▶CANADA

year amounted to 154,282 tons, compared with 134,789 tons in the same period in 1936. The company also produced 105,386 tons of zinc, as against 91,765 tons in the first nine months of last year. There has been a similar increase in the company's silver recovery, the comparable figures being 7,201,000 oz. and 6,460,000 oz. Gold was the singular exception, the company reporting a decrease from 49,757 oz. to 39,400 oz. This is thought due to receiving less custom ore. Reflecting the improvement in base-metal markets on the average this year, the Consolidated company will increase its basic wage by 25c. on Jan. 1, according to an announcement made by S. G. Blaylock, general manager, at Trail. A Christmas bonus will also be distributed to all employees with more than six months' service.

▶ Production at the Cariboo Gold Quartz mine in October established a new record, 3,251 oz., valued at $113,785, being produced from 7,862 tons of ore. A fourth unit has been ordered for the power plant, comprising a 490-hp. Ruston diesel engine and a 375-kva. English Electric generator. A new waste-heat boiler is also to be installed.

▶ Another limestone replacement orebody of high grade has been opened at the Island Mountain mine, at the 3,500 level, the lowest of several opened recently from the shaft. At the 3,625 level an orebody has been developed in limestone for a length of 125 ft.

▶ Plans have been completed for the installation of a 25-ton mill at the Quesnelle Quartz mine, situated on Hixon Creek halfway between Quesnel and Prince George. Russell Ross is superintendent.

▶ Exploratory work has been undertaken in the Zeballos River section of Vancouver Island by a number of companies formed recently for the purpose. Among these is Zeballos Gold Peak Mines, Ltd., of which T. L. Carr is president, which has under development the group of claims between the Privateer and Goldfield mines. Pioneer Gold Mines and other large operating companies are investigating properties in the region.

▶ A pilot mill of 100 tons' daily capacity is to be built immediately at the Bridge River mine of B.R.X. (1935) Consolidated Gold Mines. E. R. Shepard is managing director.

▶ As a result of the fall in the price of copper, wages paid by the Granby Consolidated company have been reduced by 5 per cent. Miners now receive $4.50 per 8-hour shift. The 3,000-ton concentrator at Allenby is being operated at capacity.

▶ Diamond drilling at the Hedley Mascot gold mine has indicated a large new orebody 160 ft. below the main haulage level, according to a report issued by the secretary, V. J. Creeden, of Vancouver. An initial dividend of 3c. per quarter, plus a bonus of 1c., will be paid by the company on Jan. 1.

▶ Development work is proceeding at the Gold Belt mine preparatory to the installation of a concentrating plant. The 2,150 level is expected to encounter the 8,000 and 8,200 veins in December. Meanwhile the ore in these veins is being blocked out above the 1,850 level. Ore has recently been developed at the low level in a new vein, the "660." Grattan Lynch is in charge of operations. Salmo is the town nearest the Gold Belt, Kootenay Belle, Reno, and Sheep Creek operations.

▶ Operations at the Vidette mine, near Savona, in the Kamloops district, have been suspended due to the shortage of available ore, according to the manager, D. B. Sterrett. It is estimated more than 14,000 tons of ore is indicated by exploratory workings, containing approximately 9,150 oz. of gold, but the company has no funds with which to continue development work.

Mexico

Unworked Claims in Federal Mining Reserve

Mining companies which have not developed ground staked prior to 1917 law are not disturbed in ownership — Labor troubles continue to beset many operations

▶ So far as can be ascertained, no mining properties of American or other interests have been expropriated by the Mexican national, State, or municipal administrations. There have been cases where mining properties have been worked by employees such as the American-controlled Amparo and Piedra Bola, in Jalisco, and the British-owned Don Carlos, in Hidalgo, but the mines still belong to the original owners. Mining claims have been expropriated if they were staked after 1917 and not worked, but mining companies that staked their claims prior to that law are not specifically being required to work them and are not being disturbed in their ownership, but whenever there is the least technicality or irregularity connected with the unworked property, it is likely to be expropriated. There have been cases of cancellation of mining concessions because concessionaires failed to perform work required by law, and there has been expropriation of other kinds of landed property, but in recent times no mining property the owners of which have abided by the law is said to have been expropriated.

▶ Only slight improvement is indicated in the Mexican mining industry with the approach of winter. Labor troubles have continued, though there were some settlements, with or without Federal intervention.

▶ Labor peace has been restored for El Arco Mining, operating at El Arco, Sonora, with the reinstatement of workers who were laid off because of flooding of part of the mines. The laying off nearly provoked a strike and prompted intervention of the Federal labor authorities.

▶ Elimination of labor troubles, at least those concerned with the bickering of unionists and non-unionists, seems to be assured in Guanajuata as a result of a meeting in Guanajuato City of mine company and miners' representatives, which was presided over by Lic. Luis I. Rodriguez, Governor of Guanajuato. A committee representing companies and workers was appointed to handle labor questions. Company representatives attending the session were: P. Ramsden, J. A. Murphy, Lic. Augustin Escudero, and Ing. Ignacio Bonillas for the Guanajuato Reduction; Alfred Wandke for Guanajuato Consolidated; Martin Quinn for Cia. Minera El Cubo, S.A.; H. Bruce, Cia. Minera El Monte, S.A., and D. Bleice and T. S. Young, Cia. Minera El Cedro, S.A.

▶ Chlorinization equipment is being installed by Cia. Minera del Boleo, S.A., a French firm, at its Santa Maria and Purgatorio copper mines, in the Santa Rosalia zone, Lower California. Miners of this company called off a boycott of

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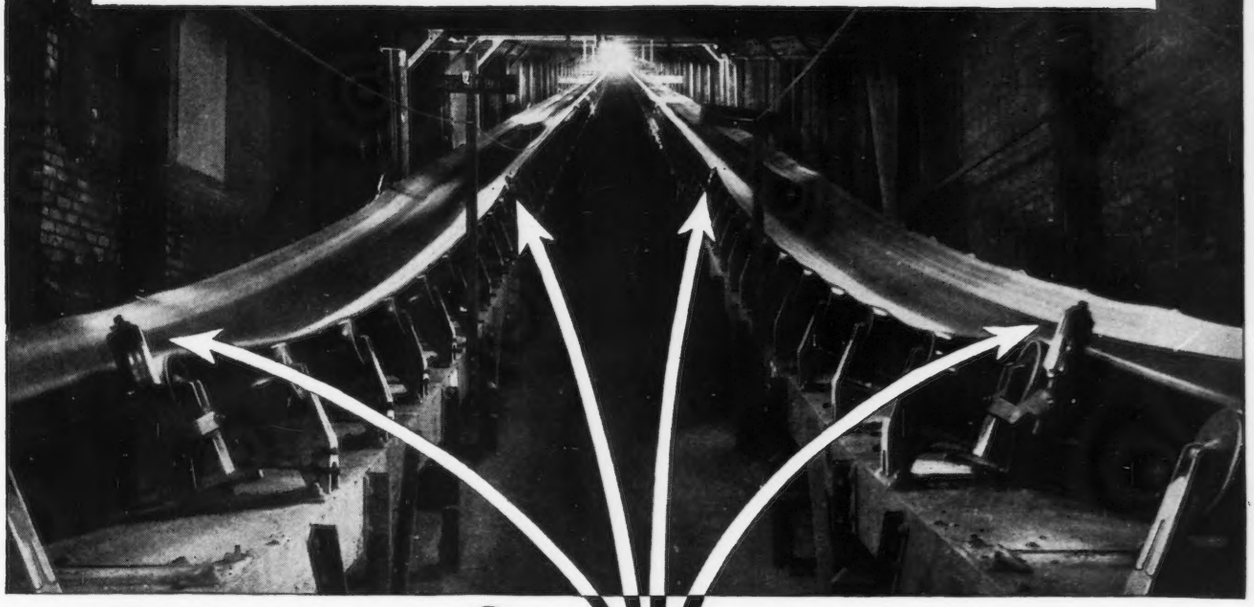
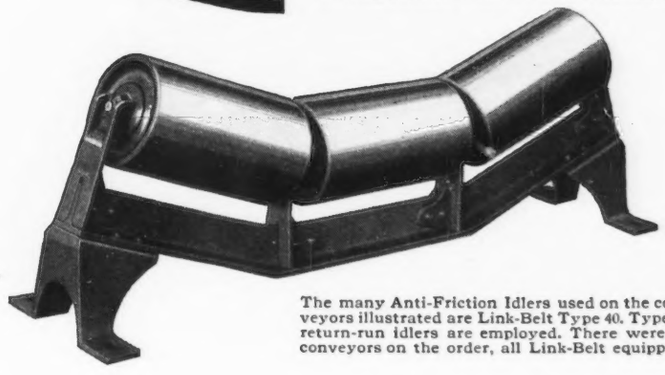


These are the Link-Belt Positive Self-Aligning Idlers, spaced at suitable intervals, that automatically maintain the conveyor belt in a central carrying position without injury to its edges.



The many Anti-Friction Idlers used on the conveyors illustrated are Link-Belt Type 40. Type 41 return-run idlers are employed. There were 20 conveyors on the order, all Link-Belt equipped.

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▶MEXICO

the firm's steamers with the settlement of a labor dispute. The company is improving hoisting and other mine equipment; also installing safety devices and building more homes for employees.

▶ Contending that work is unprofitable, Cia. Minera El Picaho, S.A., has asked for Federal authorization to suspend operations in the Cananea region, Sonora, and dismiss its 100 employees. Like sanction for similar reasons is requested by Cia. Minera de Santa Maria de la Paz, S.A., operating in the Matehuala region, San Luis Potosi, and employing nearly 1,000 men.

▶ The Federal Government has organized a cooperative society of 3,500 miners of the Pachuca belt, Hidalgo, to work inactive or abandoned properties with technical aid of the Ministry of National Economy.

▶ Triple daily wage must be paid miners who are called on to work on their weekly day off or on legal holidays—Christmas, May 1 (Mexican Labor Day), Sept. 16 (Independence Day) and Nov. 20 (Revolution Day)—according to a recent ruling by the Federal Labor Department.

▶ Depressed copper market conditions obliged Cananea Consolidated Copper to reduce the pay of its 1,400 employees an average of 5 centavos (about 1.5c.) a day. The company operates at Cananea, Sonora.

▶ Creston Colorado is arranging to resume work at its mines in La Colorado municipality, Sonora.

▶ Private and official difficulties are increasing for the cooperative society of about 1,400 employees of Dos Carlos mining which received authority to run as an experiment once rich silver properties in the Pachuca belt, Hidalgo, when the British owners asked for Federal sanction to quit work on the ground that the mines are exhausted. The cooperative cannot meet an account for 150,000 pesos (about $40,000) for electric light and power and the company wants its money. That is a serious private trouble. Grief from official sources is: the Ministry of National Economy refuses to give the mines definitely in charge of the society because it does not approve the cooperative's administrators; the society lacks the reserve fund that the cooperative society law demands, and the ministry objects to control of the unit by the national miners' union.

▶ Mining in the Altar sector, Sonora, is now being served by aviation with inauguration of semi-weekly passenger, mail, and express flights between Santa Ana, Sonora, on the Southern Pacific Railway of Mexico, and Mexicali, Lower California, by the Cooperativa de Transportes Aereos del Noroeste, an organization of army flyers.

▶ Kildum Mining ended a labor row by making a new contract which was signed for the firm by J. D. Pope, superintendent of Kildun's workings at Matehuala, San Luis Potosi.

Fiji Islands

Loloma Gold Mines Makes First Clean-Up

Bullion poured late in October—Interest aroused in new ore at the Emperor mine 50 ft. wide in crosscut

▶ Loloma Gold Mines, operating at Tavua, Fiji, reports ore reserves as at July 31 last of 138,960 tons averaging 26.8 dwt. This is an increase of 34,000 tons, but is accompanied by a decrease in grade of approximately 3 dwt. per ton compared with twelve months previously. The management reports that plant operations are all proceeding satisfactorily except that adjustments are required on the roaster to secure maximum efficiency. The first clean-up was made on Oct. 28.

▶ At the Emperior Mine, Tavua, Fiji, in a crosscut off the No. 2 (190 ft.) level at 2,070 ft. N., a width of 50 ft. of ore assaying from 7 to 12 dwt. has been encountered. This did not show in the 1,920-ft. crosscut and, coupled with good values showing in a winze at 2,075 ft. N., is of considerable interest. All shipments of machinery for the new mill have been practically completed and erection and construction is nearing completion.

Tasmania

New Companies Plan Mine Development

Properties near the Montana Western Extended group may be exploited—Renewal of scheelite mining on King Island being considered

▶ Saxon Montana Silver-Lead Development, N.L., has been formed to develop three properties near Zeehan, Tasmania. One of these adjoins the Montana Western Extended property, and the others are at South Dunbar and at Trial Harbour, each a few miles from Zeehan. Another company, Big Ben Silver Lead, will develop a second area adjoining that of the Montana company. The legal manager of Saxon Montana Silver-Lead Development is C. Cameron, 395 Collins St., Melbourne.

▶ Revival of the scheelite mining industry on King Island, between Victoria and Tasmania, is said to be planned. The deposit was worked for several years during and after the Great War, but later shut down owing to the unremunerative price realizable for the concentrates. H. P. Burns, 450 Collins St., Melbourne, is mine manager.

▶ Electrolytic Zinc Company of Australasia, Ltd., operating zinc works at Risdon, Tasmania, and mines and a concentrator at Rosebery, Western Tasmania, reports a record net profit for the year ended June 30 of £536,613. The remarkable increase in profits over £200,000 for the year, is attributed largely to the effect of increased metal prices on the operations of the company's own mines. Production at Risdon was 70,082 tons of zinc.

▶ Electrolytic Zinc has several possibilities in view for future expansion, including the production of aluminum and magnesium and an extension of zinc concentrate roasting at Risdon, Tas. The two former will be dependent upon market and other factors, and the latter upon the economic production of elemental sulphur from roasted gases, overseas practice in which is at present being investigated by an officer of the company.

Australia

Gold-Dredging Operations Delayed at Newstead

Late delivery of equipment forces initial production into first quarter of 1938—Mount Morgan plans exploitation of copper deposit by open-cut methods

▶ Operations of Victoria Gold Dredging, which is equipping an alluvial property at Newstead, Victoria, will be delayed somewhat owing to late delivery of plant and the expected date of commencement—February next—will not be realized. The dredge is equipped with 9½-cu.ft. buckets and facilities for resoiling, and has an estimated capacity of 175,000 cu.yd. per month. The area to be dredged in the first instance contains 15,000,000 cu.yd. of an average estimated recoverable value of 2.9 grains per cubic yard. There is a possibility of acquiring an additional 4,000,000 cu.yd. in the vicinity at a later date. Costs are estimate at 4d. per cubic yard, and working profit at £70,000 per annum.

▶ At the annual meeting of Mount Morgan, Ltd., the chairman, Eric Campbell, described plans to treat 7,000,000 tons of sulphide ore by open-cut methods over a period of twenty years, the ore being estimated to assay 4.2 dwt. gold and 1.7 per cent copper. Based on present prices for gold and copper, the estimated profit was 20s. per ton. This is exclusive of oxidized ores, reserves of which are 1,280,000 tons assaying 2.7 dwt. gold per ton and which are being treated at the rate of 800 tons per day. Treatment of the concentrates at Mount Morgan instead of shipping them to U.S.A. is still under consideration, Mr. Campbell added. It is estimated that a capital expenditure of £50,000 would suffice for this work, which sum could be provided out of revenue, without recourse to a fresh capital issue.

▶ North Broken Hill, Ltd., operating at Broken Hill, N.S.W., had, for the year ended June 30, a record profit of £910,627. Dividends paid aggregated £840 000, or 120 per cent on capital. Construction work on the new mill, to use the gravity

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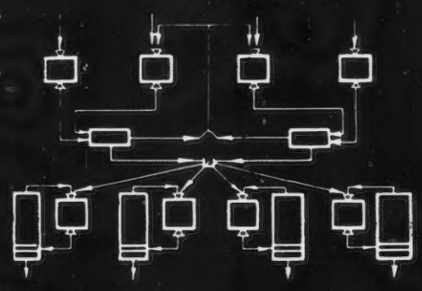
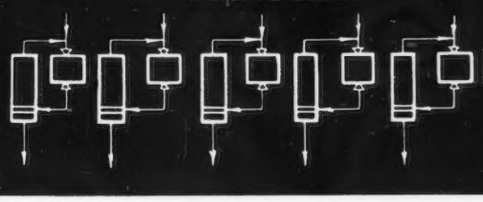


AFTER:
5 Ball Mills
5 Dorr FX Classifiers



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▶AUSTRALIA

and flotation process of treatment, is progressing well. O. H. Woodward is general manager.

▶ Operations of Broken Hill South, Ltd., also resulted in a record return, net profit for the year ended June 30 being £768,316, an increase of £282,119 on that of the previous year. Costs increased from 26s. 7d. to 31s. 3d. per ton, mainly due to the incidence of the current industrial agreement, which provides for substantial bonuses (up to a maximum of £2 per week) varying with the price of lead.

▶ Western Mining Corporation has exercised an option held over the Three Eights Mine, at Waverly, in the Ora Banda district of Western Australia. The lode, a porphyry dike averaging 3 ft. in width, has up to the present been opened up for a length of 200 ft. and to a depth of 100 ft. Crushings of development ore to date average nearly 3 oz. per ton. In addition to acting as general managers of a group of Western Australian mining companies, the company has important interests in the Central Norseman mine, at Norseman, and Fox's Find mine, at Erlistoun, W.A.

▶ Morning Star (G.M.A.) Mines, operating at Wood's Point, Victoria, reports a net profit for the year to June 30 of £16,254. The record shows that 6,174 tons of ore and 1,800 tons of dumped battery tailings were treated for a yield of 6,474 oz. gold. Production was interrupted by plant alterations and additions, completion of which was delayed by severe weather conditions.

▶ Bewick Moreing & Company, reporting on the property of Rothsay Gold Mines, Rothsay, W.A., advise that certain development work, which will probably take about five months, should be done before the plant goes into production. The remodeled treatment plant, of 2,500 tons' monthly capacity, will employ flotation to recover a cupriferous gold concentrate. Bewick Moreing & Company have now been appointed general managers of the company.

▶ Myrtleford Star Development has been formed to exploit a new find at Myrtleford, Victoria. Preliminary work only has been done so far, but it is reported that the deposit is hard quartz containing free gold and a little galena, high assays having been returned from samples taken from shallow surface trenches.

▶ Mount Coolon Gold Mine, Mount Coolon, Queensland, resumed operations recently, but the newly developed oreshoots in the western section of the property have been found to be small. Further exploration by diamond drilling in other parts of the company's area is in progress.

▶ Mount Bischoff Tin, at Waratah, during the six months to June 30, milled 6,684 tons of ore and re-treated 4,184 tons of old tailings for a total yield of 84 tons of tin oxide. To permit of the treatment of low-grade ore that will not at present pay transport costs to the main mill, two small batteries are being erected in close proximity to two of the main working faces. Operation of these units is expected to add considerably to present output.

▶ Clutha Development, Ltd., which had an option over the property of Beechworth Alluvials at Harrietville, Vic., has informed the latter company that it is unable to exercise its option. It is announced that the property has now been offered to Tronoh Mines, Ltd., of London.

▶ Completion of the dredge of Wellington Alluvials, which is to work an alluvial area on the Macquarie River at Wellington, N.S.W., is expected by the end of the year. The dredge is of 250,000-cu.yd. monthly capacity and is the largest yet planned for work in Australia. The area is estimated to contain 38,000,000 cu.yd. with a recoverable value of 7½d. per yard, with gold at old parity. At the present price of gold, inclusion of lower-grade ground will increase the payable wash to 60,000,000 cu.yd.

Africa

Drilling Indicates Copper Deposit at Konkola

Prospects appear good for another Northern Rhodesian copper mine—Mufulira's smelter capacity expected to reach over 90,000 tons of blister copper annually

▶ Rhokana Corporation did even better the past year than expected. It produced 75,254 long tons of copper from the treatment of 2,651,200 short tons of ore. The operating cost, including London and realization expenses, of the 46,247 long tons sold as blister, was £21 3s. 7d. per ton, and of the 29,007 tons electrolytically refined was £23 8s. 11d. per ton. Profit of the year ended June 30 was £2,019,866 (approximately $10,000,000). Capital expenditure during the year came to £512,026, of which £219,663 was for development. The remainder was chiefly on additions, general construction, and improvement at Nkana. Though nothing of definite value appears to have been discovered last year by the exploration of the company's concessions, diamond drilling results, Dr. Bancroft, the consulting geologist writes, "suggest strongly that at Konkola another important copper mine has been discovered, the ore from which will be of somewhat lower average grade than the other Northern Rhodesian copper mines." Konkola is on the Belgian Congo border northwest of Nchanga. Drilling (7 of 11 holes) indicates an ore horizon 14,000 ft. long (perhaps broken by a few areas of intense folding) which averages 2.63 per cent copper over an average width of 22.5 ft.

▶ The outstanding feature of Roan Antelope's year, ended June 30, was that net earnings, after allowing £175,000 for obsolescence and replacements and including all charges except taxation reserve, were well over half of its gross income. Total sales of copper came to £3,549,042 and net income was £1,790,308. Net was over 36 per cent of the total capital investment of £4,963,096. After reserving £570,731 for taxation and the amount required to pay the final dividend of 50 per cent, the company closed the year with £393,804 of net quick assets. The year's production was 69,560 long tons of blister copper, sold for prices averaging £51.022 per long ton. Cost, including depreciation and everything except taxation, was £25.496, against £24.773 the preceding year. Nearly the whole of the increased cost was due to the inclusion of £55,000 for a pension and benefit fund for employees and increased royalties due to the higher price of copper. Chairman A. Chester Beatty said at the meeting: "Additions to the mill, smelter, and power plant are now being carried out, and should be completed next year. These will increase the plant capacity to 8,500 long tons of copper per month, or about 100,000 tons per annum." He also made this interesting statement: "In the prospecting and development stages of the Roan mine, we were subject to a certain amount of criticism for accepting estimates made by our engineers based on the drilling and sampling data obtained only from boreholes. The estimates made in 1930 showed the grade of ore at the easterly end of the mine to average 3.44 per cent copper, while the actual grade as proved by systematic underground sampling and checked by mining, has been slightly higher at 3.52 per cent copper. It was also estimated in 1930 that mining by the sublevel method should result in our being able to mine 75 per cent to 80 per cent of the available ore. Subsequent mining operations have given a recover of 75.23 per cent."

▶ The net earnings of Mufulira Copper Mines for the September quarter were £324,000, subject only to taxation. Similarly, earnings for the year to June 30 were £649,998. The operating cost per long ton of blister copper last year, including London and selling expenses, was £27 13s. 2d., against £25 4s. 3d. the preceding year. Most of the increase was due to higher royalties, transportation and selling costs, and the provision of a mine pension and benefit fund. Despite the higher cost of all supplies, mining, milling, and smelting costs were all lower. Chairman Beatty said at the annual meeting: "By this time next year, when additions to plant are finished and the mine has been still further developed, we should be able to produce about 8,000 long tons of blister copper per month." It had hitherto been assumed that Mufulira's output capacity would be about 70,000 tons annually, but it apparently is to be well over 90,000 long tons, this giving it a place among the world's dozen largest copper producers.

▶ Rhodesia Broken Hill Development Company's net earnings for the current calendar year are expected to be at least £125,000, according to Sir Edmund Davis, the chairman. The campaign of deep drilling which has been under way at the property for over a year is continuing to disclose irregular but large areas of ore of high to very high grade. The values are chiefly in zinc, with fair percentages of lead and a substantial amount of vanadium.

NEW BOOKS

RETROSPECT. AN AUTOBIOGRAPHY. *By T. A. Rickard. Published by Whittlesey House, McGraw-Hill Book Company, Inc., New York and London. Pp.* 402. *Price* $3.

PASSING the traditional span of threescore years and ten, with his active life as mining engineer and editor in the background, and being now happily engaged in literary pursuits, the author offers the reader an entertaining story of his career. In some respects it follows the usual pattern of world-wide travel, acquaintance, and familiarity with large mining enterprises, but in another it is unique. Mr. Rickard supplemented and augmented his work as a mining engineer with a distinguished record as editor and author. He was successively editor of *Engineering and Mining Journal, Mining and Scientific Press,* and *The Mining Magazine;* also a frequent contributor to engineering and scientific societies. An exceptional command of the English language, in which he schooled himself, lends to his writings a charm usually lacking in technical literature. Hence "Retrospect" is entertaining as well as informative, as are also his other books, among which "Man and Metals" and "A History of American Mining" might be mentioned.

In a life replete with satisfactory and agreeable experiences, the author mentions two circumstances that occasionally give rise to irritation as well as amusement. One was the matter of his birth at Pertusola, Italy, which made him suspect of Italian citizenship. The other was a case of mistaken identity, which once led to his introduction to an audience as "Tex" Rickard, a sports promoter in the United States.

In deciding to follow mining engineering as a career, Mr. Rickard upheld a family tradition, for his father, grandfather, great grandfather, four uncles, three cousins, and a brother were members of that profession. After graduation from the Royal School of Mines at South Kensington, England, he went immediately to Colorado to begin his apprenticeship as a mining engineer. Subsequently, his professional travels took him to Australia, Alaska, Africa, and other countries. Several chapters of "Retrospect" deal with the author's trips to the far corners of the world. Others are devoted to his experiences as an editor, and contain numerous excerpts from his writings, speeches, and addresses. In these he is revealed as critic, philosopher, teacher, and preacher. Always vigorous and forceful in his comment on a wide variety of topics, the author deemed it his duty as an editor to speak his mind regardless of consequences to self or friends. Inevitably he encountered differences of opinion and even aroused antagonism, but he took counter criticism in his stride. And so in his autobiography. He speaks out on bimetallism, the League of Nations, and Edward's abdication, to mention only a few controversial topics. All are stimulating and provocative.

Although born a British subject, Mr. Rickard acquired American citizenship in 1922. But in 1935 he determined to settle down in Victoria, B. C., and in 1937 he applied for restoration of his status as a British subject. At Victoria he derives "much satisfaction from work in the garden," plays golf, and exercises his aptitude for research and writing. His autobiography is a welcome addition to mining literature and will be read with interest by mining men throughout the world.

MINES REGISTER, VOL. XIX, 1937. *Atlas Publishing Company, Inc.,* 150 *Lafayette St., New York, N. Y. Pp.* 1340. *Price* $25.

THIS VOLUME is the successor to the Mines Handbook, last published in 1931, and to its predecessor, the Copper Handbook, first published in 1900. For the first time in six years the Mines Register offers the mining industry a comprehensive directory of the principal non-ferrous metal mining companies in the Western Hemisphere. Over 4,000 active companies are listed alphabetically, with up-to-date information on their addresses, officers, history, capitalization, property, and equipment. Data on the larger companies include financial statements and dividend and production records. In addition to companies in the Western Hemisphere, the leading foreign mining companies in Africa, Australia, Germany, India, Japan, Spain, England, and Europe are also listed and described. Supplementary information includes a glossary of mining terms, a section on mineralogy, an alphabetical list of mine officers and directors, engineers, managers and purchasing agents, tables of mining security prices, and numerous statistics of the metal industry. The volume is the most pretentious of its kind issued in recent years and will be an invaluable aid to all interested in the non-ferrous metal-mining industry.

METASOMATISCHE PROBLEME. (Mount Isa, Rammelsberg, Meggen, Mansfeld, und Künstliche Verdrängung) *By Dr. Ir. C. Schouten. Published by Scheltema & Holkema's Boekhandel, Amsterdam,* 1937. *Pp.* 147 (*with* 174 *photographs and* 3 *text plates*).

BETWEEN the covers of this booklet is contained one of the most interesting recent contributions to the study of ore deposits. The author states his aims with unusual frankness and directness in the opening paragraphs. Realizing the controversial nature of his publication, Dr. Schouten introduces his subject by naming as his adversaries Dr. Hans Schneiderhöhn and Dr. Paul Ramdohr, of Germany, and states the principal differences in opinion. The prominent German scientists, authors of the classic "Lehrbuch der Erzmikroskopie," have supported the syngenetic origin of the German ore deposits discussed by Dr. Schouten. Not only does the author disagree with this viewpoint on the basis of the microscopic evidence, but the positive and authoritative manner of presentation by the Germans arouses his undisguised disapproval.

This exhaustive investigation of the four well-known ore deposits of Mount Isa (Australia), Rammelsberg, Meggen, and Mansfeld (Germany) is limited exclusively to a microscopic study of polished sections of ore specimens. Geological field data are obtained from the literature and serve merely as a background for the development of microscopic evidence in support of the author's views on metasomatism. The conclusions reached by this exceedingly detailed and most critical study of metasomatic evidences of ore deposition can be stated best in the author's own words: "It suffices for our present purpose to prove that other possibilities for explanation of the genesis are not to be excluded and that the essential proof for sedimentary origin has not as yet been offered."

The reader's special attention might be directed to a chapter on "Laboratory Experiments in Ore-Replacements." Eight actual experiments in artificial ore deposition are described and their results evaluated in terms of natural occurrences.

One hundred and seventy-four fine photographs of polished sections, some taken with oil immersion at a magnification of X 2000, and about 90 drawings of pseudomorphic structures are important supplementary features of the booklet.

In view of the general excellence of this publication it is unfortunate that the author has chosen to be rather thrifty with references to the literature. Although he repeatedly mentions outstanding investigators by name, mainly in support of his own views, he generally neglects to list the actual article or publication to which the reader might refer in an extended investigation of the stated contentions.

The language used is German of the "colloquial" type which flows along smoothly, but presents many difficulties for the foreign reader because of its idiomatic phrases, intricate sentence structures, and lengthy, albeit colorful and descriptive, words.

KURT E. LOWENSTEIN

▼

PUBLICATIONS RECEIVED

✦*The Division of Geology,* Tennessee Department of Conservation (Walter F. Pond, State Geologist), Nashville, Tenn., has issued the following pamphlets by George I. Whitlatch, Associate Geologist: Markets Circular No. 1 Tripoli, pp. 12; No. 2, Bauxite, pp. 11; No. 3, Limestone, pp. 12; No. 4, Manganese, pp. 15; No. 5, Molding Sand, pp. 16; and No. 6, Clay, pp. 35.

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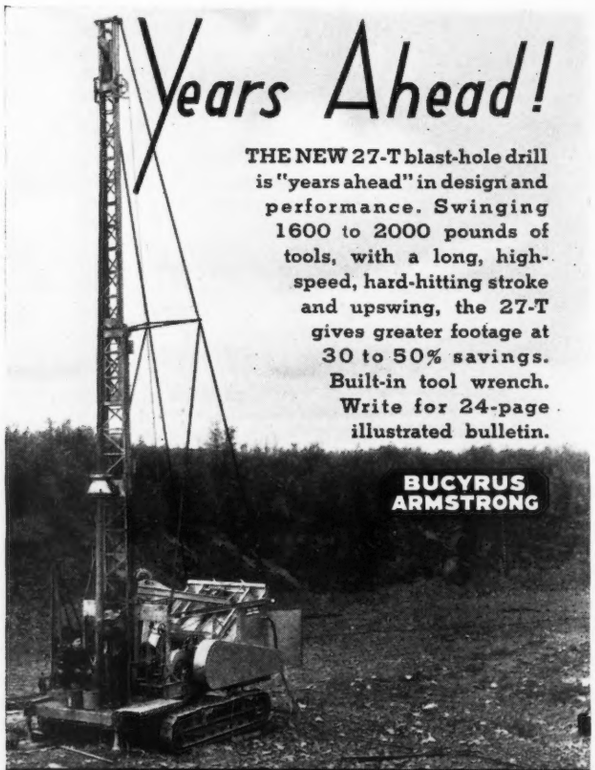

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THE NEW 27-T blast-hole drill is "years ahead" in design and performance. Swinging 1600 to 2000 pounds of tools, with a long, high-speed, hard-hitting stroke and upswing, the 27-T gives greater footage at 30 to 50% savings. Built-in tool wrench. Write for 24-page illustrated bulletin.

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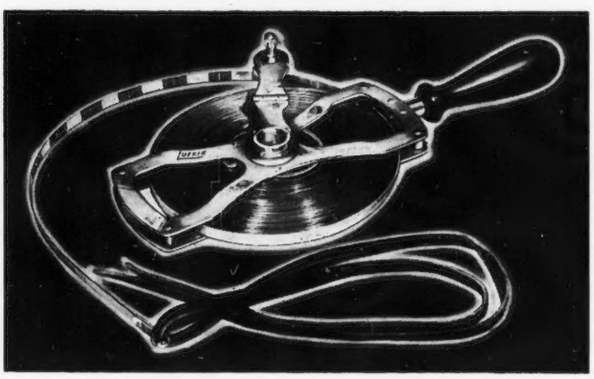

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When you choose a Lufkin "Michigan" chain tape you've chosen a tape that's built for hard service. The markings are deeply stamped in long-wearing Babbitt metal. The sturdy dull-nickeled reel effectively resists weather and wear. Every part of a Lufkin "Michigan" tape—frame, tape-line, handle and even the brass end-clips and leather thongs are designed and built for hard use. And records of their performance prove they can "take it." See your nearest dealer or write for free illustrated catalog No. 12.

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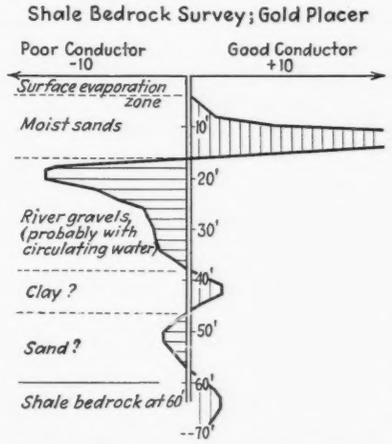
EQUIPMENT NEWS

Geophysical Prospecting Device

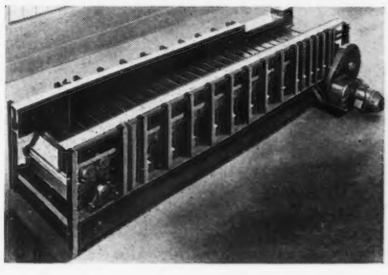
A NEW PROSPECTING DEVICE known as the "Resistance Gradiometer" is announced by the Heiland Research Corporation, 700 Club Building, Denver, Colo. The device may be applied to the location of gold placer channels and location of groundwater. Use of the instrument is also said to include locating vertical boundaries such as faults, contacts of igneous rocks, mineral-bearing dikes, and all types of conductive ore veins. The instrument is completely self-contained, with bridge amplifiers, batteries, galvanometer, and scale. Use of a generator instead of batteries is said to have advantages which the manufacturer says eliminates the troublesome commutator, makes replacements unnecessary, and furnishes much greater power, leading to more reliable results (200 watts driven from a ½-hp. engine). Furthermore, the device is said to be economical in operation, and it can be left stationary for any number of traverses radiating out from one power electrode. Calculations to obtain depth to formation boundaries are said to be unnecessary with this instrument, as it is direct-reading and stratigraphic interpretations of formations are possible immediately from the field data. An example of indications obtained is shown in the accompanying cut.



Apron Feeder

LINK-TRACK Engineering Company, 230 North Michigan Ave., Chicago, Ill., has introduced the Rorabeck apron feeder, which is designed primarily for feeding ore and stone to crushers, screens, and other process equipment. A combination of welding and bolting is said to provide a rigid structure capable of withstanding the impact of materials dropped from considerable height or with great force, without the usual distortion and stretching of the apron attendant upon such use.

The apron flights are of manganese steel and have reinforcing ribs running their full length. Connecting links are cast integral with flights and are said to be so constructed the fines cannot sift through between flights. S. K. F. ball bearings are used on the driving and idling shafts, being inclosed in a dust-proof housing with hardened metal seal rings. The feeder is reversible and is said to feed with equal facility, and has no vibration, traveling in either direction. The feeders are available in any length and in a wide range of standard widths.



Mechanical Bit Construction

E. J. LONGYEAR COMPANY, Minneapolis, Minn., announces a new idea in setting bortz in corebits. A patented process is used wherein the bortz is held in place within a mold into which

is poured the bit metal. Upon cooling, the bortz crystals are said to be more firmly imbedded in the bit than those set by hand. The manufacturer states that this type of mechanical construction assures accuracy of size, with each stone set to perfect gage. Cost of these bits is said to be roughly two-thirds of the cost of hand-set bortz bits. The large number of cutting points allow high bit rotating speeds with low pressure, and the bits will drill many formations where hand-set bortz bits are used. In solid formations it is said they will obtain equivalent footage with carbon bits or hand-set bortz bits. When a dull bit is returned to the manufacturer for resetting, credit is allowed for the usable bortz at its original purchase price.

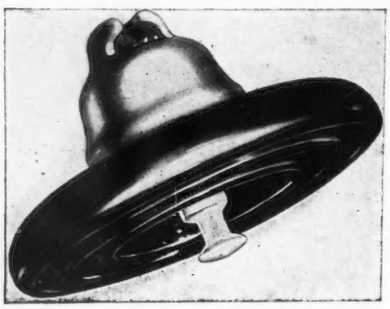
Vertical Centrifugal Pump

A NEW VERTICAL, close-coupled motor-driven centrifugal pump for general service in deep or shallow wells has been announced by Fairbanks, Morse & Company, 900 South Wabash Ave., Chicago, Ill. This pump was designed to meet the recognized need for a small-diameter, low-capacity, dependable pump with low initial and operating costs. It is said to be ideal for economically pumping water under either high or low pressure at 6 to 60 g.p.m. Because of compact construction, only a small space is needed for installation, an important feature where floor space is limited. Simple in design, quiet and dependable in operation, the pump requires a minimum of attention and no lubrication is necessary. Units for shallow well service consist of combined motor, pump and base, into the bottom of which is screwed a single suction pipe extending below the water level. This is satisfactory for water lifts of 15 to 20 ft. Pumps for use in wells 20 to 200 ft. deep are equipped with an ejector and venturi in one of two drop

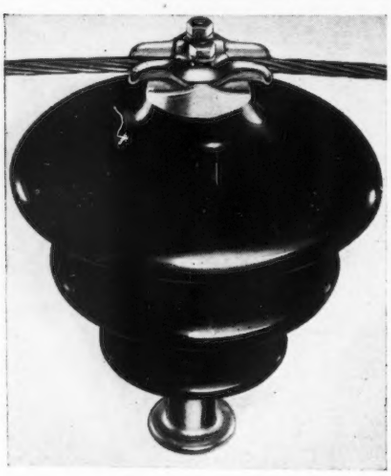
pipes extending from the pump down into the well. This deep-well pump operates on the accepted principle of the centrifugal pump, with the ejector added to lift water from depths beyond that from which a centrifugal pump alone will lift it. By allowing a predetermined amount of water from the pump discharge to bypass down one of the drop pipes in the well and back up through the ejector into the venturi, a vacuum is created above the ejector nozzle, drawing well water into the suction chamber. The high velocity of the water through the venturi, and the mixing of the two streams of water, lifts the well water to within reach of the pump suction. Positive water lift is insured.

Rugged Suspension Insulators

TWO RUGGED SUSPENSION insulators, one of petticoat design and one with a smooth disk, have been announced by the Ohio Brass Company, Mansfield, Ohio. These insulators, known as Huskitypes, are said to be provided with high impact resistance to minimize breakage from various forms of missiles. The petticoat-type



here illustrated is intended for use on lines which are subject to rock throwing and which demand an insulator with standard flashover values and full leakage distance. The other type, designed to deflect missiles from its smooth under surface without damaging the insulator, is for use on lines which are subject to gun fire. Both types have a 10-in. disk and a 15,000-lb. M. & E. rating, and are available with either a 5- or 5¾-in. spacing. The company also announces a new line of three pin-type insulators, said to



eliminate the need for tie wires. Known as Clamptops, they are said to be free from radio interference at voltages 1.4 to 3 times normal line to ground voltages. A malleable iron casting is cemented into the porcelain head of the insulator, and the clamp proper rests on two pintles in this casting, thus allowing a teeter-totter movement of the clamp. With the insulator in position, it is only necessary to lay the conductor in the clamp, place the keeper piece over the conductor, slip a lock washer over each bolt, and tighten the nuts. The three sizes have 10½-, 12-, and 13½-in. diameters, and are for ordinary line voltages of 34.5, 46, and 69 kva., respectively.

Air-Line Freeze Preventative

AN ADDITIONAL and improved system of air-line and air-tool freeze preventative known as "Frosto" is announced by the Sullivan Machinery Company, Michigan City, Ind., to supplement "Tanner Gas." Frosto has been developed particularly for industrial applications and wherever electric current is available for its operation. In operation, the Frosto is vaporized in a "vaporizer" and is fed into the compressed-air line near the compressor as fast as necessary to prevent freezing of water vapor in the compressed-air lines and air tools. This system is said to be effective and economical. About a quart of Frosto is required to treat 100,000 cu. ft. of free air under severe conditions of temperature and humidity.

Mounting on Drive Pulleys and Flywheels

A NEW FIBER-LAGGING with improved clamp used to increase the diameter of pulleys and flywheels is announced by the Rockwood Manufacturing Company, 1801 English Ave., Indianapolis, Ind. Increasing the diameter of the driven pulley permits increasing the size of the motor pulley and results in higher belt speed. The manufacturer states that compared with cast iron the fiber surface will transmit at least 50 per cent more power and often increase output of driven machines 10 per cent or more.

The compressed end grain fiber belt surface is said to make an ideal pulling surface that grips and pulls the belt without slip. The laggings are supplied in any width and up to 72 in. in diameter. They are applied by clamping on the wheel rim with a simple perfected clamp.

Dust-Tight Capacitors

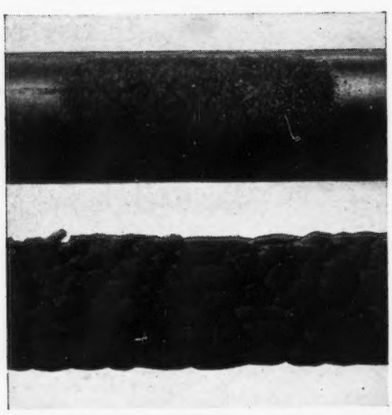
A NEW LINE of dust-tight capacitors has been developed by Westinghouse, East Pittsburgh, Pa., for use in mills and plants with dust-laden atmospheres to protect the live parts from an accumulation of foreign materials. These capacitors consist of three component parts; namely, the capacitor unit proper, the dust-tight terminal compartment, and the mounting supports. The capacitor unit is of the Inerteen type in a heavy welded sheet-steel case with rugged porcelain terminals mounted into the case. The units are available in 5 and 7½ kva., 230-volt, 60 cycle ratings, and 5, 10, and 15 kva. 460- and 575-volt ratings. They are designed to meet all standard N.E.M.A. and A.I.E.E. tests. They are said to be impregnated and filled with a fluid which will not support combustion and which will not give off gases which support combustion in any combinations with air.

Rail Bender

THE TALLMAN Manufacturing Company, Shelbyville, Ill., reports the manufacture of an aluminum rail bender said to be made from a special aluminum alloy particularly adapted to the application, having one-third the weight of steel but being equivalent in strength. The manufacturer states that up to this time no material exclusive of an aluminum alloy has been developed for the application having the same strength in proportion to weight. The design includes Timken roller bearings and adopts the feature of either push or pull bending by equipping the bender with the proper number of thrust bearings and a particular type of screw. Five types are made, for rails from 12 to 80 lb., and the binders weigh from 21¾ to 43 lb. respectively.

Gasoline-Engine-Driven Portable Welder

A NEW, single-operator, portable welder, combining the improved Type WD-32B General Electric arc-welding generator and a standard 60-hp. Ford



CHLOROPRENE RUBBER, known as Neoprene, for use on cables as a safeguard against fires originating from power circuits in mines, is announced by E. I. du Pont de Nemours & Company, Wilmington, Del. In the illustration, the result is shown when the upper piece of Duprene-covered cable was held over a flame and the cover burned slowly while the flame was present, but when removed the fire went out. The rubber-covered cable at the bottom caught fire and the flames spread along the cable. The manufacturer lists among other advantages besides fire resistance, the resistance to oil and cracking from outdoor exposure

Flames for Sale!

PROGRESSIVE master mechanics of mines, mills and smelter machine shops have long considered cutting and welding equipment the indispensable tool to repair broken traction gears and pinions, grinding and crushing equipments; to build up worn teeth on cast or steel gears; to cut and weld chute and bin linings; speed up and cheapen shrinkage operations.

VICTOR equipments are designed and constructed with such interchangeability that the mere addition of a different type or size of welding nozzle or cutting tip offers the prompt solution for any specific job.

Experienced and dependable VICTOR distributors, located from Coast to Coast, bring VICTOR equipments, promptly to any mine, mill or smelter.

Your superintendents will find the VICTOR Welding and Cutting Apparatus Catalog desirable---promptly forwarded upon request.

(Victor Equipment Company are the manufacturers of "KIMBALL KROGH" Pumps.)

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V-8 engine, has been developed by the General Electric Company, Schenectady, N. Y., so that successful arc-welding can be done independently of electric-power-line service. Designated as Type WD-32BY, the new welder is said to have a NEMA rating of 200 amp., 40-volt arc, 1 hour, 50 C, 60 to 200 amp. welding range. The complete unit, 24 in. wide, 60 in. long, and 43 in. high, can be loaded crosswise into practically any truck body. Net weight is approximately 1,250 lb.

Faster Detonating Fuse

ENSIGN - BICKFORD COMPANY, Simsbury, Conn., announces a new flexible detonating fuse called Primacord. This fuse is said to have a faster detonating wave than the company's Cordeau-Bickford fuse. The fabric covering affords greater flexibility with minimum weight, suitable tensile strength, and good waterproof qualities. Other advantages listed by the manufacturer are lightness and easy handling; also that main lines can be laid closer together than can lines of Cordeau, as there is no metal covering to cause injury to the adjacent lines through propellant action.

BULLETINS

Vibrating Screens. Allis-Chalmers Manufacturing Co., Milwaukee, Wis. Bulletin 1,478A describes and illustrates low-head horizontal vibrating screens.

Pyranol Capacitors. General Electric Co., Schenectady, N. Y. A loose-leaf brochure, handsomely illustrated, showing manufacture of pyranol capacitors used in industry for power-factor improvement. **Trolleys.** GEA-2639 describes GE trolleys for mine and haulage locomotives. **Line Break Equipment.** GEA 2646 describes starting equipment for mine locomotives. Pp 2. GEA 2434 describes indoor potential transformers.

Pumps. Fairbanks-Morse & Co., Chicago, Ill. Bulletin 6640 describes and illustrates a new vertical, close-coupled, motor-driven centrifugal pump, for general service in deep or shallow wells. Pp. 6.

Stopers. Sullivan Machinery Co., Claremont, N. H. Bulletin S7-S-9 describes the S-9 and S-20 light-weight stopers. Pp. 4. **Hoists**—Bulletin 76-C announces new and improved type of Sullivan shaft hoists. Pp. 15.

Pyrometers. Wheelco Instruments Co., 1929 South Halsted St., Chicago, Ill. Bulletin 503 is on small to large 8-in. scale portable indicating pyrometers. Pp. 8.

Hard Facing. Haynes Stellite Company, Kokomo, Ind. A comprehensive booklet describing and illustrating numerous economic applications of the hard-facing process. Pp. 104.

Earth Resistivity Apparatus. Geophysical Instrument Co., Washington, D. C. Circular "A" describes the manufacturer's equipment for mineral prospecting. Pp. 4.

Water Works Manual. The Youngstown Sheet & Tube Co., Youngstown, Ohio. This flexible-covered, loose-leaf binder, 9x11½ in., is a general practical book containing data on steel pipe in water mains, laying methods, corrosion, tuberculation, incrustation, leakage and breakage factors, fittings and service connections, tables, and other useful data. Pp. 120.

Belt Maintenance. B. F. Goodrich Co., Akron, Ohio. Catalog Section 2800 describes the care and maintenance of conveyor and elevator belting and serves as a guide to economical material handling with rubber belts. Pp. 20.

Resistance Gradiometer. Helland Research Corporation, Club Building, Denver, Colo. Folder RG-1 describes an electrical geophysical prospecting device used in determining ore deposits and depth to bedrock in dam sites and gold placers. Pp. 6.

Vanadium Steel Castings. Vanadium Corporation of America, 420 Lexington Ave., New York, N. Y. Booklet describes properties and applications of a number of vanadium alloy steels for castings requiring high strength and without excessive weight. Pp. 24.

Water Control. The Mercoid Corporation, 4201 Belmont Ave., Chicago, Ill. Bulletin 125 describes the "Immersatherm," an instrument designed for close regulation of the domestic water supply on steam and vapor systems. Pp. 4. Bulletin 223 describes the Mercoid Type DA-37 vapor vacuum control. P. 1.

Insulating Brick. Quigley Co., 56 West 45th St., New York, N. Y. Sheet describes advantages and characteristics of "Insulbrix." P. 1.

Machining Aluminum. Aluminum Company of America. A pocket booklet containing detailed data on machining of aluminum and its alloys. Pp. 32. Aluminum Paint Manual is also a practical booklet for those interested in the use of aluminum paint. Pp. 102.

Telebrineller. Teleweld Ind., Railway Exchange Bldg., 80 East Jackson Boulevard, Chicago, Ill. Folder describes operation and uses of a 6½-lb. portable device to test metal hardness.

Technical Information. International Nickel Co., 67 Wall St., New York, N. Y. Bulletin T-13 is "Nickel and Nickel-Base Alloys" and their use in design of corrosion-resistant machinery and equipment. Pp. 27. Bulletin T-14, "Design and Construction of Heavy Equipment in Monel, Nickel, and Inconel." Pp. 23.

Asbestos Cement Pipe. Johns-Manville, 22 East 40th St., New York, N. Y. Bulletin TR-11A describes and illustrates use of asbestos cement pipe. Pp. 32.

Belt Conveyor and Bucket Elevator Hand Book. Stephens-Adamson Mfg. Co., Aurora, Ill. Catalog 47 lists the manufacturer's products and contains useful, condensed conveying practice data for engineers and is well illustrated. Pp. 124.

Acid-Proof Cement. Quigley Co., Inc., 56 West 45th St., New York, N. Y. Bulletin A.P. 122-R describes types of acid-resistant brick for use in the metallurgical industry. Pp. 8.

Air Filters. The Northern Blower Company, West 65th St., Cleveland, Ohio. Bulletin 500-3 illustrates and describes the "Norblo" square-type air filters, automatic and designed for continuous service. Pp. 4.

Timken Engineering Journal. Timken Roller Bearing Co., Canton, Ohio. A complete revision of the General Information Section of the *Timken Engineering Journal* has just been completed and copies are available upon request to Timken Roller Bearing Co. The data presented in this loose-leaf volume, which is furnished in a standard 8½x11 in. three-ring binder with stiff covers, include a general discussion of the design and types of Timken Bearings now available, a discussion of ratings and bearing selection, methods used for calculating bearing loads for a wide range of fundamental applications, and complete detailed information as to bearing sizes and load-carrying capacity. For the convenience of designers, accurate full- and half-size detail bearing drawings are presented for the complete list of single-row Timken Bearings up to an outside diameter of 14 in. Pp. 296.

Electrode Holder. Jackson Electrode Holder Co., 6553 Woodward Ave., Detroit, Mich. Small folder describes the manufacturer's insulated electrode holder and lists parts and prices.

Drifters. Ingersoll-Rand Co., 11 Broadway, New York, N. Y. Folder 2357 describes the DA-30 light-weight drifter. Pp. 4.

Flexible Metal Hose. Seamless Co., 5-19 48th Ave., Long Island City, N. Y. Bulletin 365 describes flexible bronze metal hose called Triple Safe Tubing for various industrial uses. Pp. 2.

Compressors. Chicago Pneumatic Tool Co., 6 East 44th St., New York, N. Y. Bulletin 762, describes the Class WO-2 portable and WCO stationary diesel-engine compressors. Pp. 7.

Steel Hard-Facing Procedure. Linde Air Products Co., 205 East 42d St., New York, N. Y. A pamphlet issued by the manufacturer describing method of hard-facing materials. Pp. 8.

Duracord Tree Wire. Anaconda Wire & Cable Co., 25 Broadway, New York, N. Y. Publication C-36 includes description, tests, and insulation thickness of the manufacturer's wire used for suspension through trees. Pp. 8.

INDUSTRIAL NOTES

American Council of Commercial Laboratories has been organized with a charter membership of twenty laboratories in different parts of the United States. Its object is to promote the welfare of independent testing laboratories and to maintain high standards of ethics and technical service. A declaration of policies, to which members have subscribed, is designed to insure satisfactory relations between laboratories and clients. Officers of the new organization are: President, Preston S. Millar, Electrical Testing Laboratories, New York, N. Y.; vice-president, Monroe L. Patzig, Patzig Testing Laboratories, Des Moines, Iowa; secretary, D. E. Douty, United States Testing Company, Hoboken, N. J.; treasurer, A. E. Ellis, Pittsburgh Testing Laboratory, Pittsburgh, Pa.

Mine Safety Service, 24 South 10th St., Martins Ferry, Ohio, maintains a poster service said to be devoted specifically to prevention of mine accidents.

American Hoist & Derrick Company, of St. Paul, Minn., announces the appointment of Stanley M. Hunter as manager of sales for the company.

Sullivan Machinery Company, of Chicago, Ill., has opened a branch office in Picher, Okla., with J. Donahoe, field representative in charge, assisted by Richard Dodd.

The 1938 National Safety Congress will be held in Chicago, Ill., Oct. 10 to 14 at the Stevens Hotel.

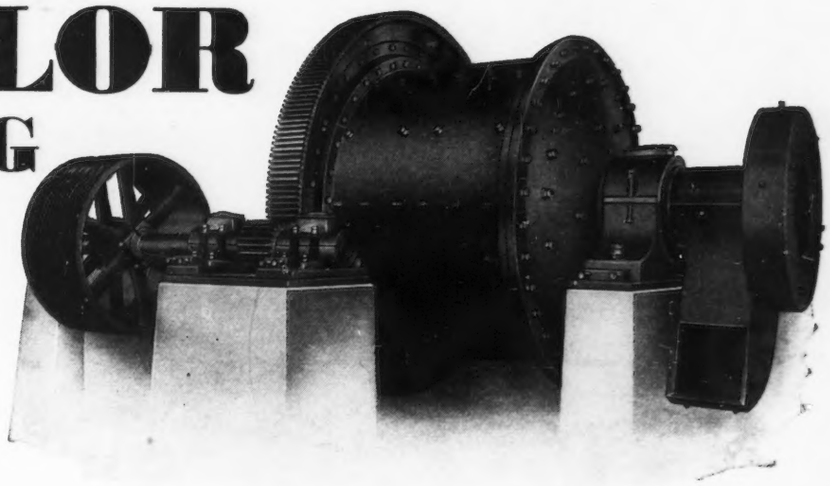
Mine & Smelter Supply Company, of Denver, Colo., announces the opening of an office at 369 Pine St., San Francisco. This office will serve mining companies and industrial companies in northern California and western Nevada.

Formation of a division of engineering and research by Crane Company, of Chicago, with L. W. Wallace, head of engineering research for the Association of American Railroads, as director, effective Dec. 1, has been announced by Charles B. Nolte, president of Crane Company. The new Crane division will comprise the existing division of research and development and the product engineering department of the company.

"Modern Metalworking with the Oxy-Acetylene Flame," a new two-reel silent motion-picture film that depicts the construction and operation of the oxy-acetylene torch and the oxy-acetylene process for joining and severing metals, is the latest addition to the film library of the United States Bureau of Mines, Department of the Interior.

Frank Piatt, president of the American Refractories Institute since Sept. 1, 1935, with offices in Pittsburgh, has resigned his position to accept an appointment as a vice-president of the Mexico Refractories Company, Mexico, Mo., according to an announcement just made public by J. B. Arthur, president of the company.

TRAYLOR GRINDING MILLS have made good for about 30 years!



● It has made no difference

how hard or how soft the ore was, or how coarse or how fine it was to be ground, or whether grinding was to be wet or dry,—always there has been a Traylor Mill that did the job better, more quickly and more economically.

As it is with all things, there are reasons, and the one big reason for the preeminence of Traylor Grinding Mills, is that our engineers have always made an intensive study of grinding and the needs of operators and are, therefore, in position to build equipment that performs exactly as required.

Appreciation of our efforts has come in two ways—by continuous patronage (the best possible form), and by voluntary expressions of satisfaction on the part of users.

So, whether you need a ball mill, a rod mill, tube mill, pebble mill, and whatever you wish to grind at whatever rate, to whatever fineness, be assured that you need look no further than Traylor.

The proof is printed to some length in our Bulletin 1103. Send for your copy, today!

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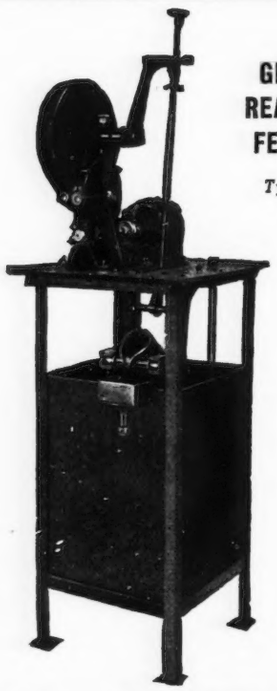
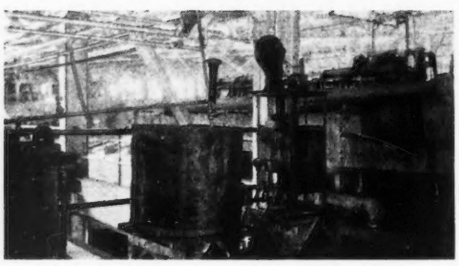
The GEARY REAGENT FEEDER Insures Constant Feeding



GEARY REAGENT FEEDER

Type A



One Geary Reagent Feeder after fifteen years of constant feeding. This machine is still operating satisfactorily.

Leading large and small mining and chemical companies of the world take no chances. They rely on—

GEARY REAGENT FEEDERS

Because here is protection that assures:

Uniformly high metallurgical efficiency.
Increased Profits.
Protection against losses from fluctuating recoveries.
Protection against waste of reagents.

There is a Geary Reagent Feeder to suit your individual needs. The Geary Feeder has a wide range of feed regulation and a capacity of from ½ c.c. to 5 gals. per minute; is automatically operated; repair and maintenance costs are practically nil — The Geary Feeder is ruggedly built and there is nothing to wear out; is compactly built and requires little space.

One Geary Reagent Feeder user writes: "I take pleasure in informing you that the operation of the feeders was entirely satisfactory. We have not a criticism to make, nor can we offer a suggestion for their improvement, considering them about perfection as a reagent feeder."

What more can we add? Our many satisfied Geary Feeder users tell the whole story.

Write today for Bulletin 362 which gives complete information on Geary Reagent Feeders.

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MANILA, P. I.—Earnshaws Docks & Honolulu Iron Works

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BOOTH-THOMPSON DIVISION ENGINEERING SERVICE

THE GALIGHER COMPANY

228 SO. W. TEMPLE ST. (Established 1901) SALT LAKE CITY, UTAH

BOOTH-THOMPSON DIVISION

To the Point!

A large Mining Company recently sent their Consulting Metallurgical Engineer to Denver to see our test mill in action. After he had seen the mill perform, we asked him what he thought of the New ABCO Mill with Positive Double-Action Grate Discharge. He replied:

"This Mill does everything any other good Grate Ball Mill can do, but none of them can do what the ABCO does."

N.B.—He is recommending ABCO Mills for his grinding job to replace Grate Mills of the conventional type.

Why not have your Consulting Metallurgical Engineer pay us a visit? It will be worth his while and to your advantage. The Mill is hooked up with a standard classifier and flotation cells, and all test runs can be made on a commercial scale. All facilities to accurately check the results are at hand. You may run a few tons or a carload of your own ore through the mill, if you so desire. Drop us a line!

AMERICAN BALL MILL COMPANY
PATTERSON BUILDING
DENVER, COLORADO, U.S.A.

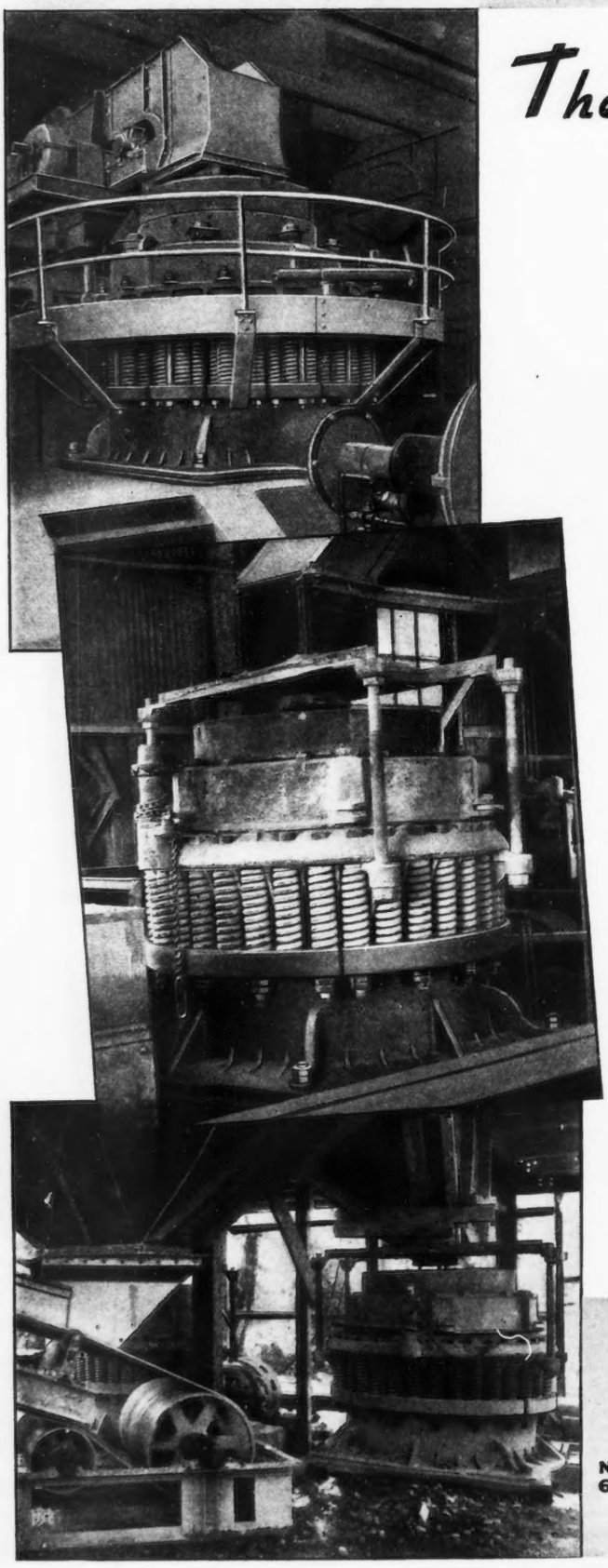
THERE ARE NO OTHER MILLS WITH POSITIVE DISCHARGE

"If it isn't an ABCO it isn't MODERN"

The New ABCO BOLTLESS LINED Ball Mills

PATENTED AND PATENTS PENDING IN THE U.S.A. AND PRINCIPAL FOREIGN COUNTRIES

SYMONS CONE CRUSHERS



There are reasons why

so many of the more prominent producers of metals have standardized on Symons Cones for their reduction crushing operations. This is true not only in the metallic field but in the non-metallic as well. They are to be found in most of the modern mills of recent construction.

The Symons Cone was developed primarily for reduction crushing. Its unusual crushing process, its different construction, its special operating features, all combine in giving this Crusher its enormous capacity of fine product. By providing an increased tonnage of better ball mill feed, overall crushing and grinding costs are greatly reduced. There is little wonder that Symons Cones are to be found throughout the world where metals are produced in quantity.

With the Symons Standard Type Cone built in seven sizes with crushing heads ranging from 20 inches to 7 feet in diameter, and the Short Head Cone in four sizes, there is a Cone for any capacity and size of product that may be desired. When confronted with a fine crushing problem, see what Nordberg has to offer in the Symons Cone.

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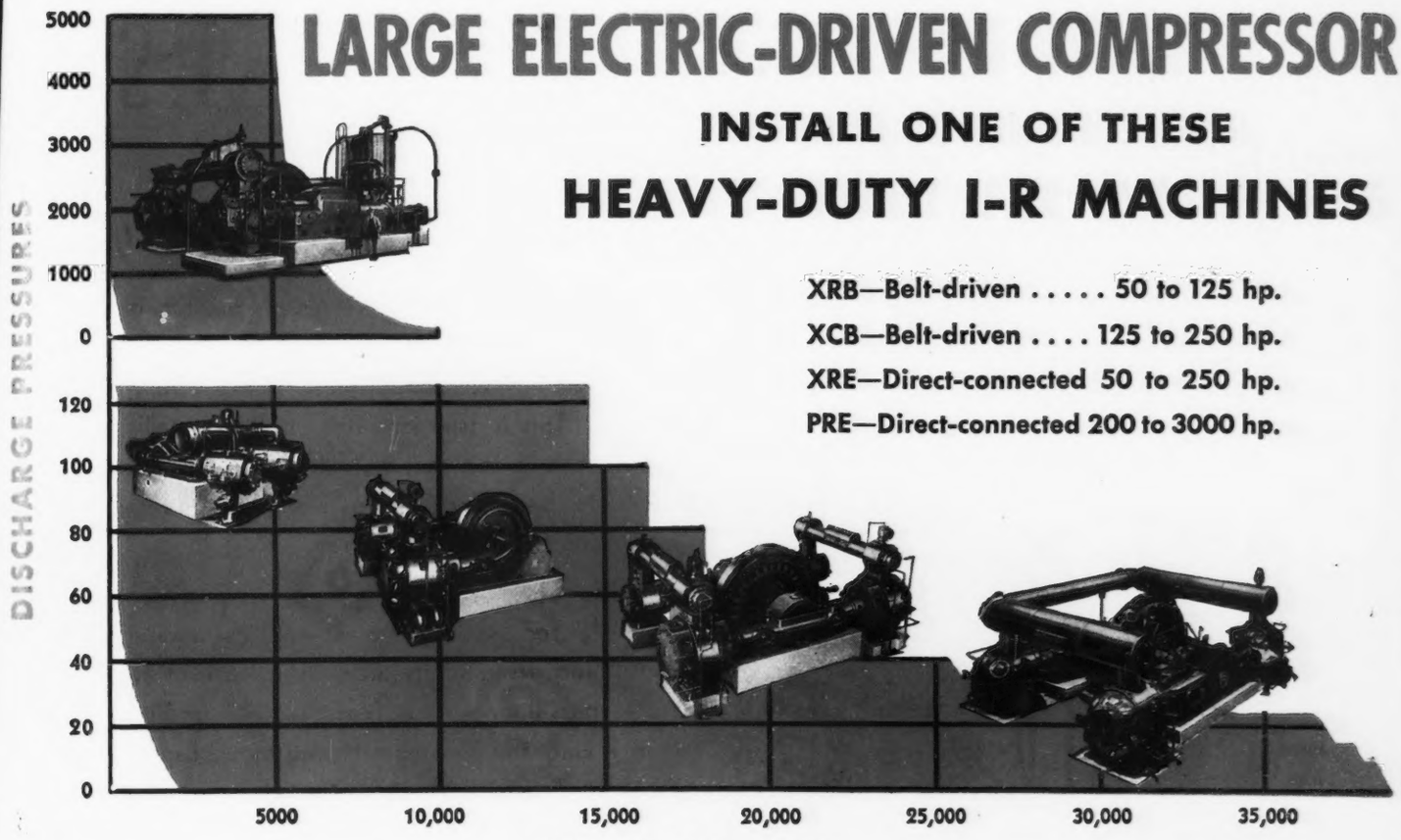
WHEN YOU NEED A

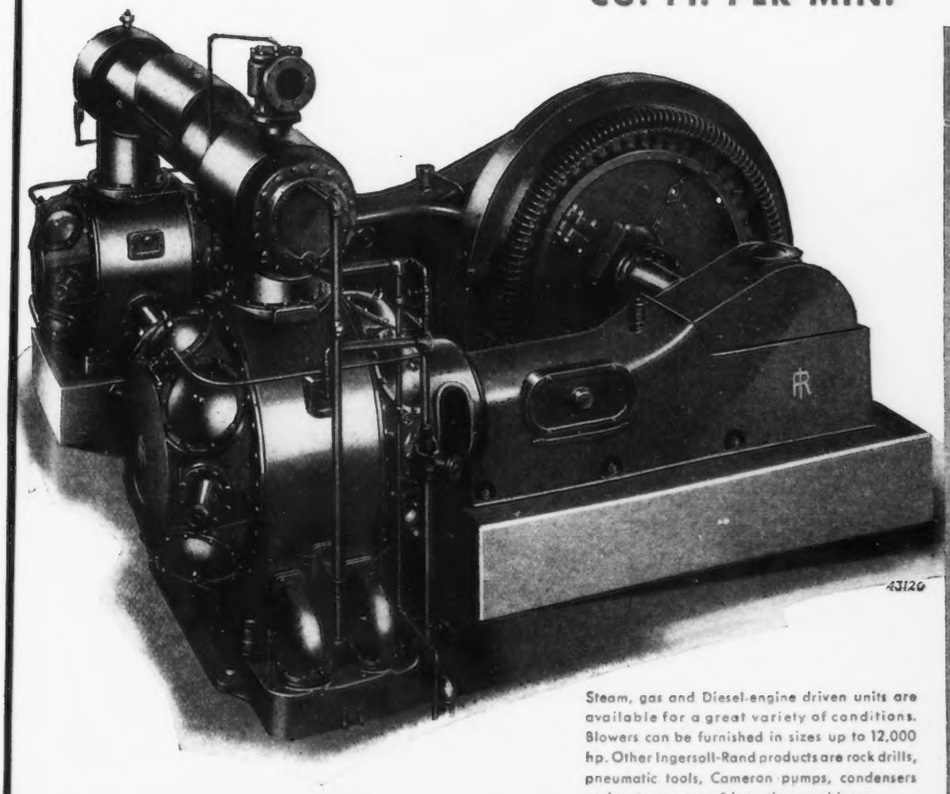
LARGE ELECTRIC-DRIVEN COMPRESSOR

INSTALL ONE OF THESE

HEAVY-DUTY I-R MACHINES



XRB—Belt-driven . . . . . 50 to 125 hp.
XCB—Belt-driven . . . . 125 to 250 hp.
XRE—Direct-connected 50 to 250 hp.
PRE—Direct-connected 200 to 3000 hp.



Steam, gas and Diesel-engine driven units are available for a great variety of conditions. Blowers can be furnished in sizes up to 12,000 hp. Other Ingersoll-Rand products are rock drills, pneumatic tools, Cameron pumps, condensers and water-vapor refrigerating machines.

GENERAL TYPE—Horizontal duplex, double-acting, crosshead type. ("Four-corner" construction for larger sizes.)

DRIVE—Direct-connected synchronous motor in any size; flat or V-belt up to 250 hp.

RATING—Continous full load, 24-hours per day, day in and day out.

SERVICE—Air; poisonous or inflammable gases; synthetic gases; ammonia.

STAGES OF COMPRESSION—1, 2, 3, 4, 5 or 6 according to conditions.

VALVING—Channel valves: silent, efficient and durable.

SIZES—50 to 3000 hp. for capacities and pressures shown by the red chart above.

EFFICIENCY—Most efficient electric-driven compressors on the market.

REGULATION—Five-step clearance control, conceded to be the best method of regulating large synchronous motor-driven compressors for pressures up to 125 lbs. Above 125 lbs., regulation furnished to meet conditions.

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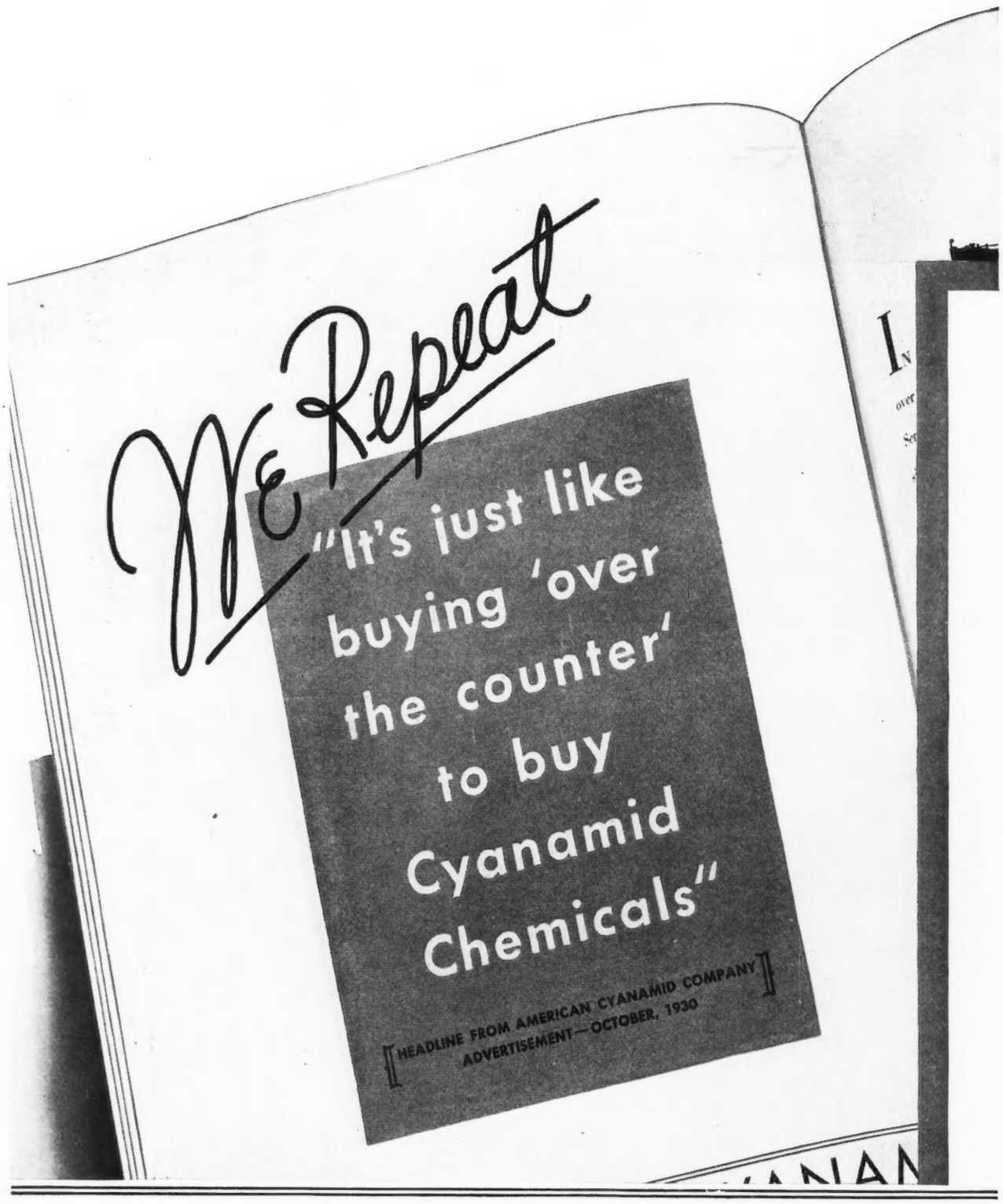
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"It's just like buying 'over the counter' to buy Cyanamid Chemicals"
HEADLINE FROM AMERICAN CYANAMID COMPANY ADVERTISEMENT—OCTOBER, 1930

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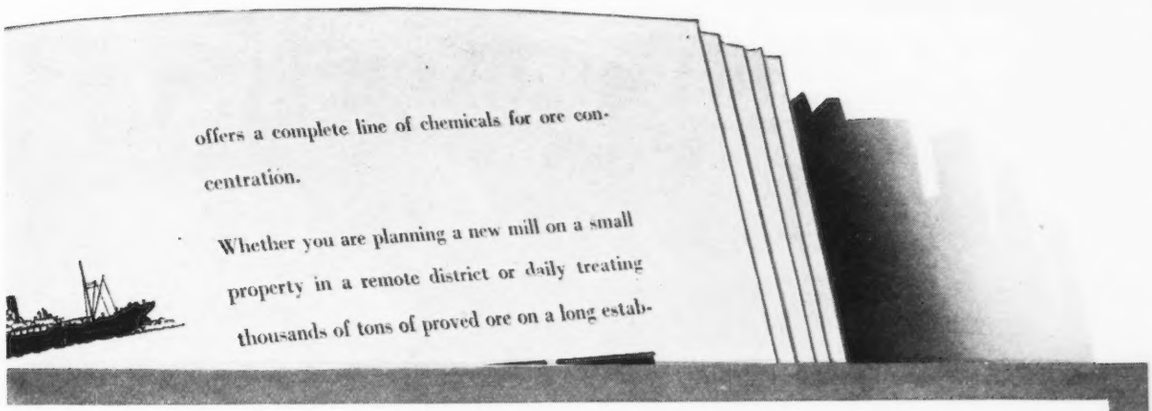
30 ROCKEFELLER PLAZA,


offers a complete line of chemicals for ore con-
centration.
Whether you are planning a new mill on a small
property in a remote district or daily treating
thousands of tons of proved ore on a long estab-

offers a complete line of chemicals for ore concentration.

Whether you are planning a new mill on a small property in a remote district or daily treating thousands of tons of proved ore on a long estab-

lished lode, you will find that it costs no more to take full advantage of Cyanamid Service. In fact, it costs far less when you consider all the resultant economies.

IN these past seven years hundreds of mills all over the Mining world have found that Cyanamid Service actually does make chemical buying as simple as an "over the counter" transaction. These mills have benefited by the economies of centralized purchases, combination shipments and bed-rock inventories. They have found that Cyanamid Service disregards distance . . . "that the Rand gets the same service as the Rockies".

Just as important many mills have profited by the practical assistance of Cyanamid field engi-

neers and the Cyanamid Ore Dressing Laboratory in working out better flow sheets and applying exactly the right reagents to the ore being treated. They have found Cyanamid Service trustworthy and unprejudiced because Cyanamid

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ORE DRESSING NOTES No. 7 deals with flotation reagents, the most rapidly changing phase of flotation. The properties and uses of the newest reagents as well as those of many familiar chemicals are described. We shall be pleased to send not only a copy for you but also as many additional copies as may be useful to others in your organization.

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NEW YORK

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ONLY THOR ROCK DRILLS HAVE . . .

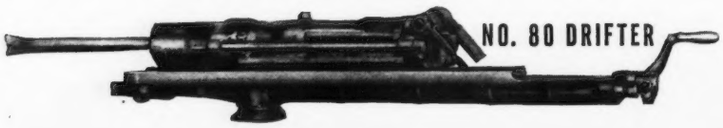
Measured Air

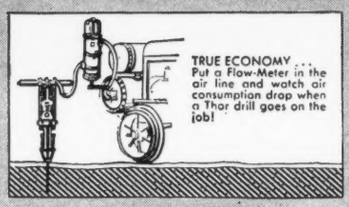
EVERY INCH OF POWER FROM EVERY FOOT OF AIR — Thor

BASIC REASON FOR SUPER-DUTY AT AMAZING *Savings*

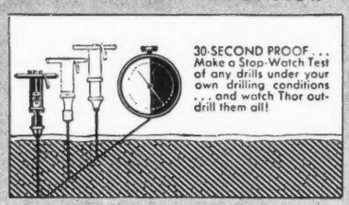
• *'Measured Air'*, the new principle in rock drill construction that gets "Every Inch of Power . . . From Every Foot of Air", is found only in Thor Rock Drills. Only Thor has perfected a valve that precisely controls the quantity of air admitted to the back of the piston hammer so that it functions perfectly on every stroke . . . assuring smooth, dependable operation.

But smoother operation . . . with its resultant longer life . . . is only one of the advantages of Thor Rock Drills. For *'Measured Air'* brings superiority in ALL FOUR Basic Features that mean super-duty performance and amazing air economy. Get PROOF of performance before you buy another rock drill. Test all Four Features shown at the right on your own work. And for facts on how you can get faster drilling at lower cost, write today for your copy of an interesting booklet called, "What is 'Measured Air'?".

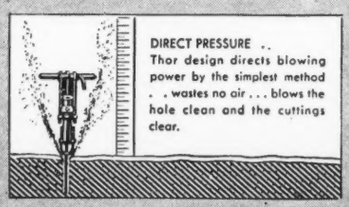




LOWER AIR CONSUMPTION



FASTER DRILLING SPEED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NO "STUCK" STEELS . . . "Measured Air" brings EXTRA power for positive rotation. Thor drills keep going in the most difficult formations.

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SULLIVAN SHAFT SLOPE AND SUPPLY HOISTS Offer

Easy Portability — through Sullivan all steel construction which means less weight per horse power; can be transported anywhere.

Built for Hard Service — through double life gears and ball and roller bearings; totally enclosed.

Simple Operation — with quadrant locking, band type friction brake and clutch; all safety devices available.

Less Floor Area — hoist, motor, and control all mounted on unit base; low installation cost.

Drive Adaptable to Conditions — through base designed for Sullivan "Turbinair" or electric motor drive.

Wide Capacity Range — 75 different capacities and speeds available on each unit of the same horse power and size through 2-step gear reduction.

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Complex Metallurgical Problems Solved *with* DENVER PILOT MILL

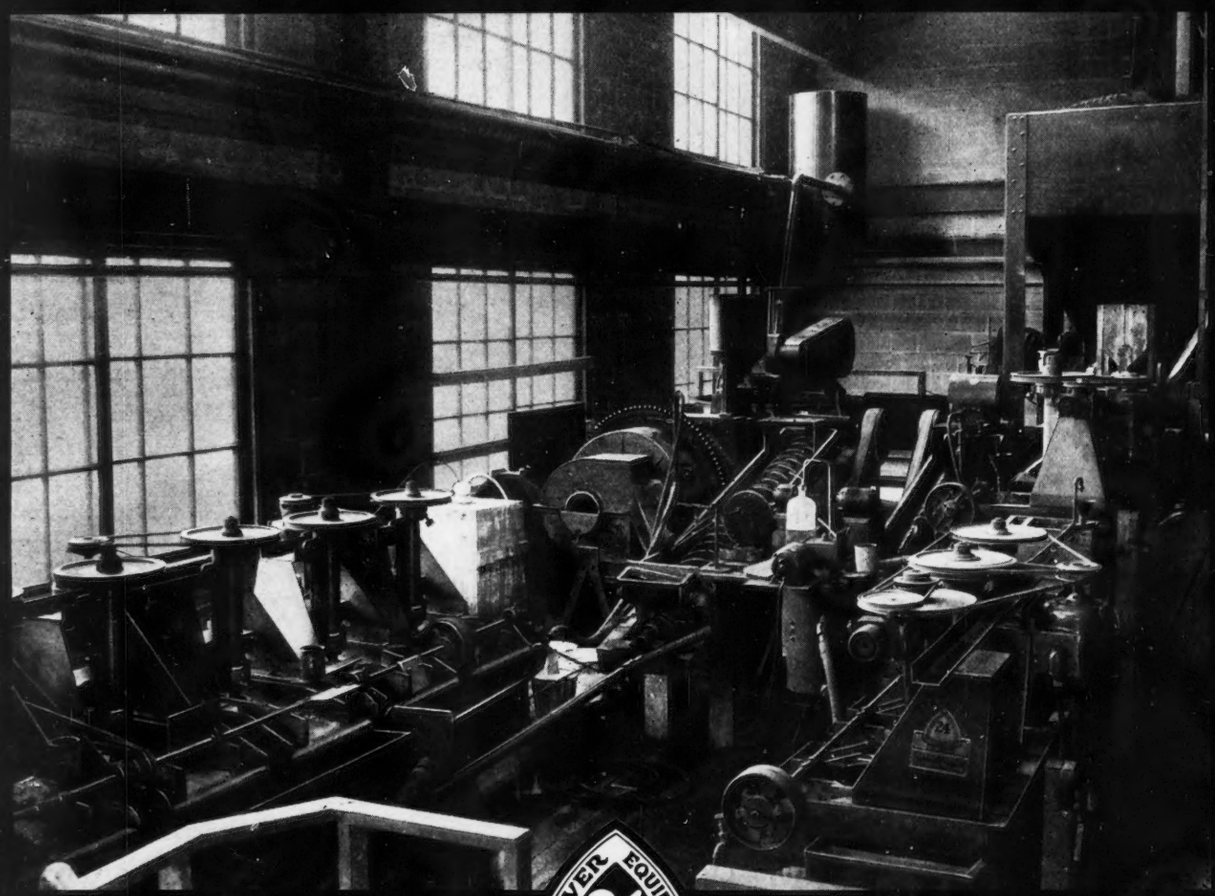
This Denver Pilot Mill was built to work out a new metallurgical problem on a particular ore. The results were so successful that the equipment was used for experimental purposes on other ores. By utilizing this flexible method of developing new flowsheets, the loss of time and expense of tying up a large milling plant was eliminated and possible improvements and economies were indicated.

The universal acceptance of Denver Test Units by mining companies, government departments and schools, is due to the fact that test results are accurate, reliable and results can be duplicated in actual practice.

Whether you need a laboratory machine or a complete milling plant "from crusher to filter," write Denver Equipment Company.

This Denver Pilot Mill consists of:

1–7" x 10" Denver Jaw Crusher
2–30" x 36" Denver Rod Mills
1–No. 50 Denver Unit Flotation Cell
2–12" Denver Rotary Classifiers (High Weir Type)
1–6-cell Denver "Sub-A" (Fahrenwald) Flotation Unit
1–3-cell Denver "Sub-A" (Fahrenwald) Flotation Unit
1–5' x 5' Denver Tray Thickener (Spiral Rake Type)
1–¾" Denver Vertical Sand Pump



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WHAT DO YOU MEAN—

"MOST POWERFUL COLLECTORS"?

We have consistently stated that the Amyl Xanthates are the "Most powerful collectors of all the commercial Xanthates." The success of users has demonstrated this fact for many years, but sceptical flotation men may naturally ask, "How and Why?" Here are the answers: First answer is Gaudin's Rule: ***Xanthates become the more active collectors the larger the number of carbon atoms in the alcohol radical.*** Maximum collecting activity in the commercial Xanthates is reached with 5 carbon atoms—the structure of the Amyl Xanthates.

Second answer is that Pentasol Amyl Xanthate is made with Sharples Pentasol Amyl Alcohol—formulated from ***five*** Amyl Alcohols!

The great collecting power of Pentasol Amyl Xanthate has made it especially effective on ores difficult to float. It has brought in highly satisfactory recoveries on oxidized and semioxidized ores, on complex sulphides, on native gold and silver. It is turning in profits from flotation of highly oxidized gold tailings 40 years old!

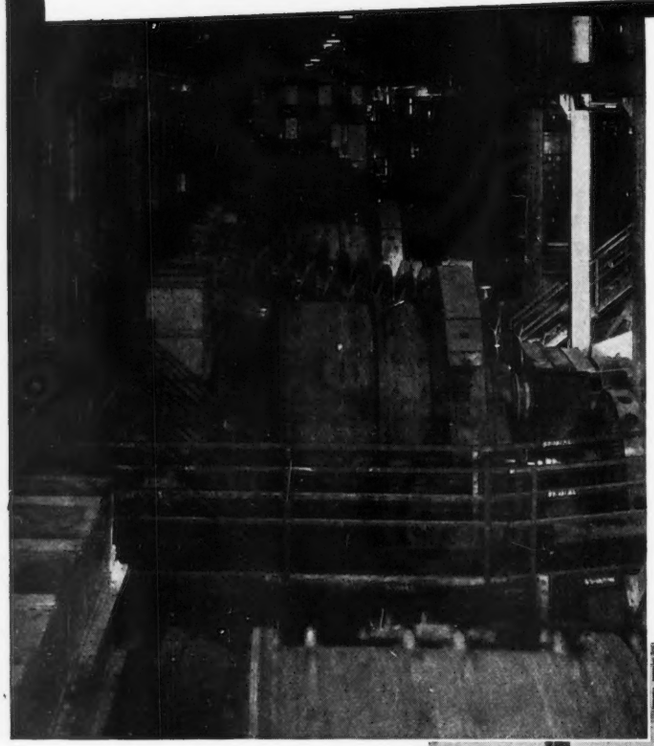
Have you a difficult recovery job? Test runs will quickly demonstrate what Pentasol Amyl Xanthate can do to help you improve recoveries. We will gladly supply free samples of Sharples Pentasol Amyl Alcohol or the commercial Xanthate made from it.

SHARPLES TRADE MARK SOLVENTS

SHARPLES SOLVENTS

THE SHARPLES SOLVENTS CORP., 23rd and Westmoreland Sts., Philadelphia, Pennsylvania

In Steel Alloys as in Gold, MARCYS *are Standard*

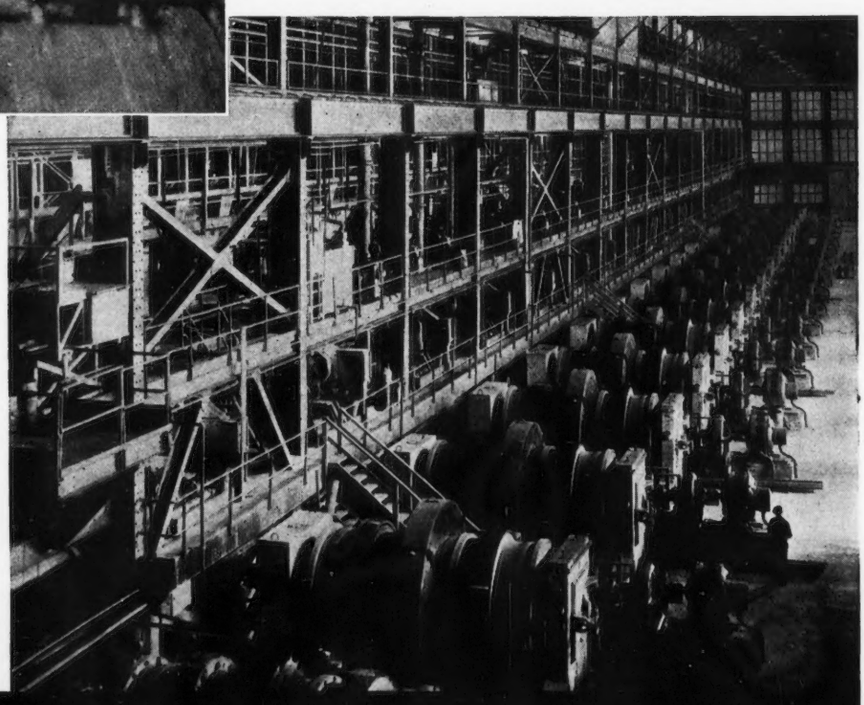


IN SELECTING grinding equipment for *any* plant, three factors deserve prime consideration BEFORE the choice is made: (1) *efficient grinding*; (2) *low-cost upkeep*; and (3) DEPENDABILITY. If this is true, there is significance in the fact that International Nickel and Climax Molybdenum, the world's largest producers of two important steel alloys, are *both* users of MARCY Mills exclusively.

With international interest centered on increasing production of gold, it is even more significant that MARCY Mills are the predominant choice of operators in every important gold mining camp in the world.

Present day MARCYS embody important improvements--including a **NEW Open End Ball Mill** which creates even more rapid and positive ciculation of the mill content.

State YOUR problem
Let's talk it over



Above: Climax Molybdenum; six orders for Marcy Ball Mills since this plant was built. Below: International Nickel; three orders for Marcy Open End Rod Mills since the experimental tests were made. "Such confidence must be deserved."

•

WILFLEY Tables
MASSCO Rock Bit Grinders
Clark-Todd Amalgamators
Adams Reagent Feeders

•

MINE, MILL and LABORATORY SUPPLIES

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Complete Milling Plants

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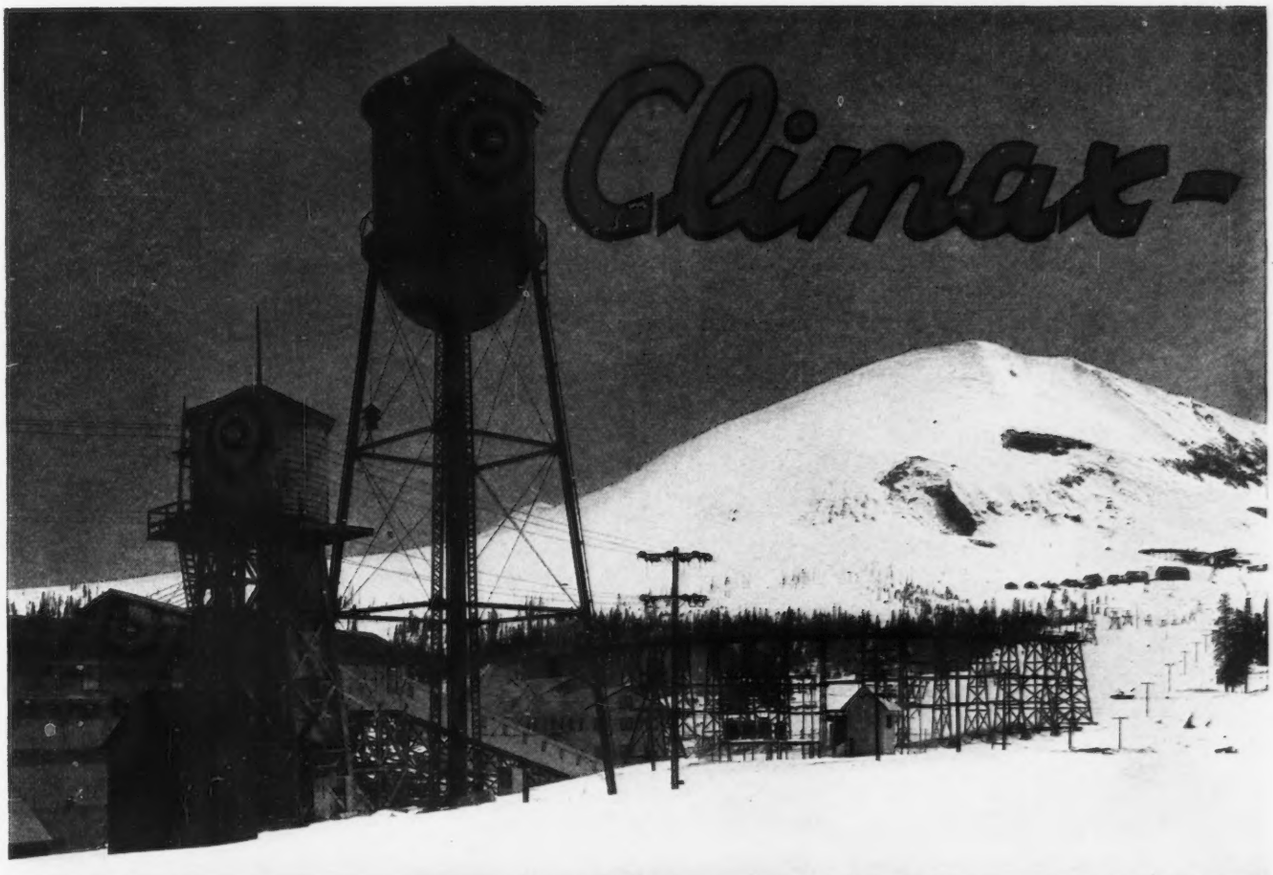

CHOOSES O-B DEPENDABILITY

TONNAGE is on the upswing at Climax! With the steadily growing demand for molybdenum the forward-looking Climax-Molybdenum management has been faced with the problems of increased tonnage flow and increased plant capacity—problems which they have solved, deftly and surely.

In maintaining haulage flow at new peak levels O-B materials have played an interesting and impressive role. Long experience with these famous products has made the Climax management well aware of their dependability and long life. As a result you will find O-B trolley and feeder clamps, hangers, insulators, current taps, trolley wire and feeder splicers, section insulator switches, safety feeder switches and a multitude of similar products helping to lower costs and speed up tonnage flow at Climax.

OHIO BRASS COMPANY

MANSFIELD, OHIO, U. S. A.

Canadian Ohio Brass Company, Ltd., Niagara Falls, Canada

(Representatives in all principle foreign countries)

1937M

O-B's Extra Life Brings You An Extra Profit

CP DRIFTERS

CP-60 Drifter with Standard HAND FEED

CP-60 AUTOdrifter with Automatic SPEEDfeed

for

- FAST DRILLING SPEED
- LOW AIR CONSUMPTION
- UNUSUALLY LOW MAINTENANCE
- RENEWABLE BUSHINGS AT ALL MAIN WEARING POINTS
- FREEDOM FROM VIBRATION (FULLY CUSHIONED)

Sizes: 3" • 3 1/2" • 4"

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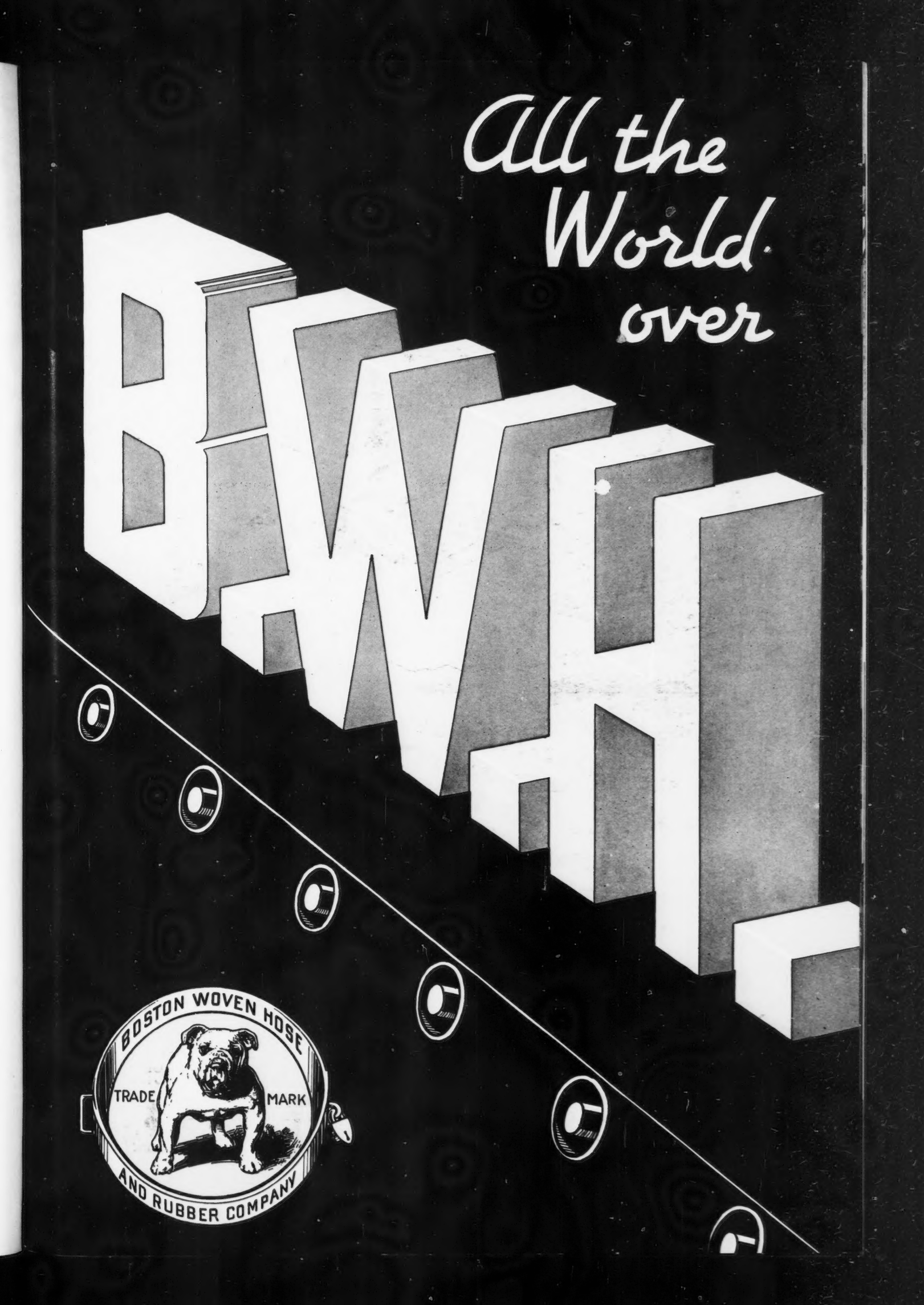
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THE DUPLEX SYSTEM for Conveying Materials

U. S. PATENT NO. 1,626,041

The Duplex System comes to the relief of operators whose conveying problems involve the frequent replacement of expensive conveyor belts due to the character of the material handled, and saves money because of the principle on which it is built. The wear sheet absorbs the abuse takes the clawing and scratching of the roughest and the most jagged loads while the power belt which carries the wear sheet on its back remains in service through several wear sheet replacements.

Our Engineering Department will gladly go over your specifications and determine how you can profit by the Duplex System the most important development in the history of belt conveying.

BOSTON WOVEN HOSE & RUBBER CO.

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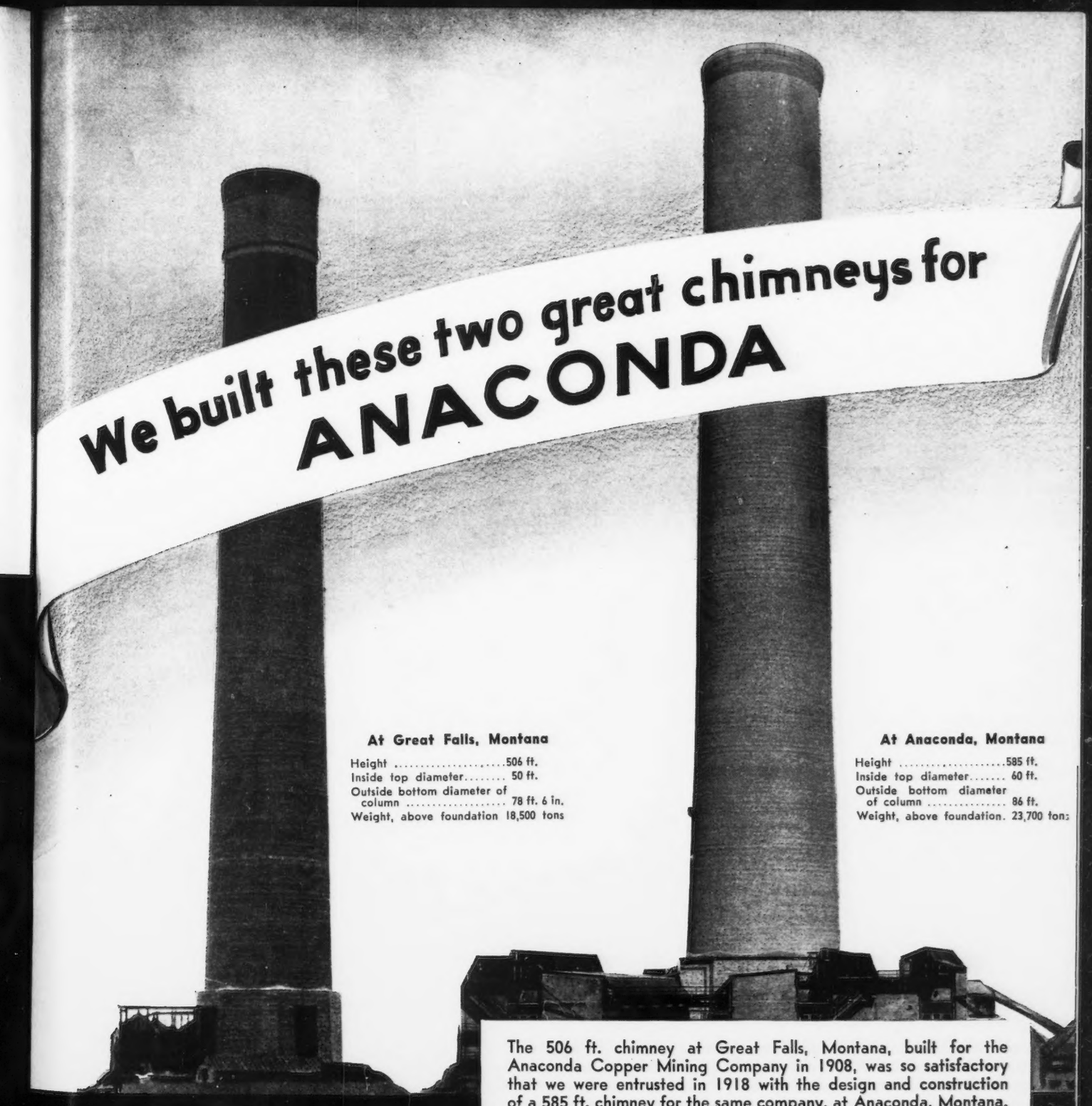
We built these two great chimneys for ANACONDA



At Great Falls, Montana

Height .....506 ft.
Inside top diameter..... 50 ft.
Outside bottom diameter of column ..... 78 ft. 6 in.
Weight, above foundation 18,500 tons

At Anaconda, Montana

Height .....585 ft.
Inside top diameter..... 60 ft.
Outside bottom diameter of column ..... 86 ft.
Weight, above foundation. 23,700 tons

The 506 ft. chimney at Great Falls, Montana, built for the Anaconda Copper Mining Company in 1908, was so satisfactory that we were entrusted in 1918 with the design and construction of a 585 ft. chimney for the same company, at Anaconda, Montana.

Although no longer the tallest chimneys in the world, they are the largest in both diameter and weight—also in the quantity of gases handled.

Complete information regarding these two great chimneys is contained in an illustrated booklet entitled *"The World's Tallest Chimneys"*; which also tells about seven other great smelter chimneys which every mining man should know about.

If you would like a copy of the *"The World's Tallest Chimneys"* write for it today. We'll be glad to send it—without charge or obligation of any kind.

ALPHONS CUSTODIS CHIMNEY CONSTRUCTION CO.

NEW YORK CHICAGO
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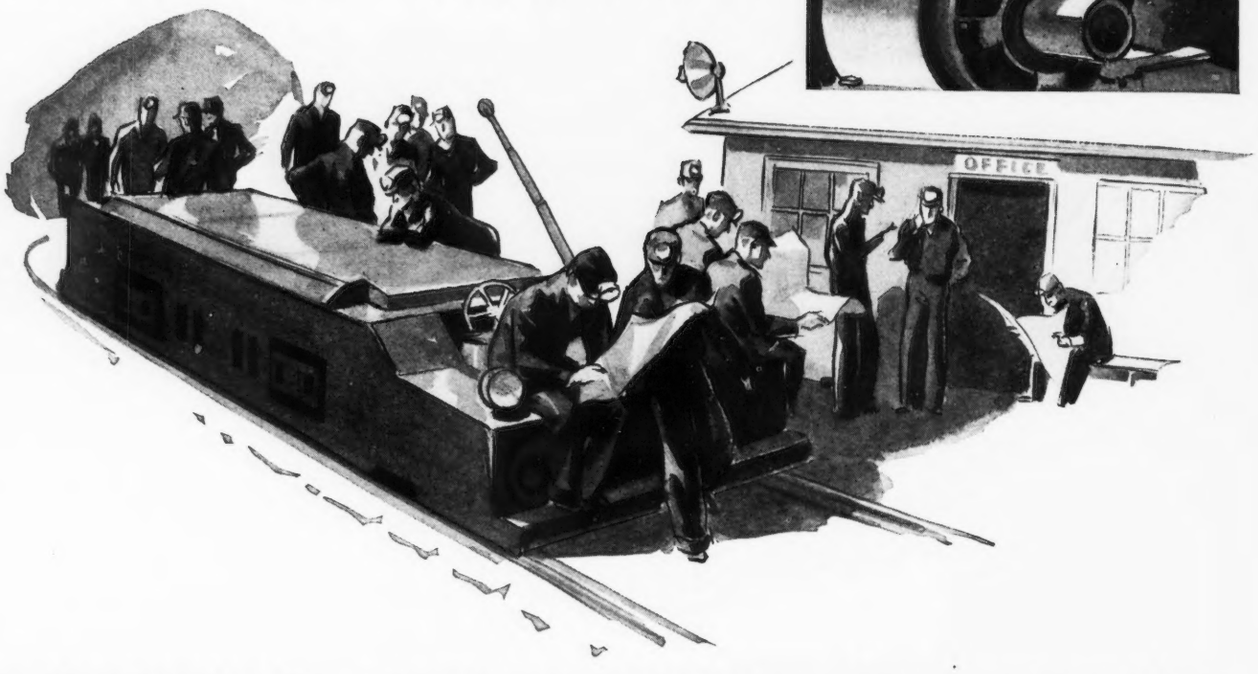
These Men Must Stand and Wait



PROTECT Your Electrical Equipment with DELTABESTON WIRE AND CABLE

An interruption in power supply due to insulation failure seldom confines its damage to one motor. Instead, it spreads into every corner of your mine. Production lines become jammed. Expensive man power stands idle. Profits go into hiding until long after the trouble is remedied.

Fortunate for you that you can specify Deltabeston Wire and Cable. Purified Asbestos Insulation is immune to the damaging effects of excessive heat, moisture, oil and grease. Conditions that impair the reliability of ordinary asbestos-insulated conductors have no effect on Deltabeston. Deltabeston leadership is proven daily.

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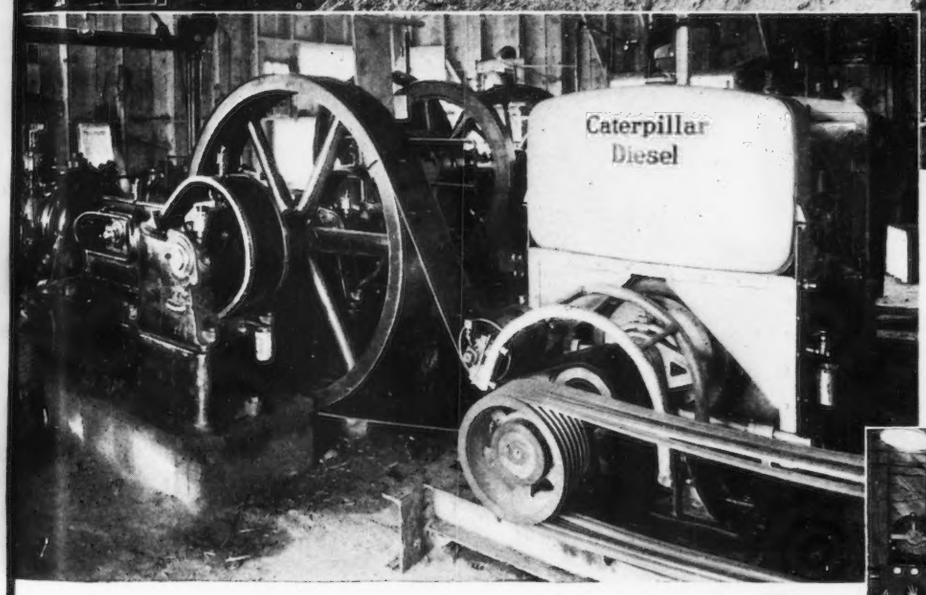
DELTABESTON WIRE AND CABLE

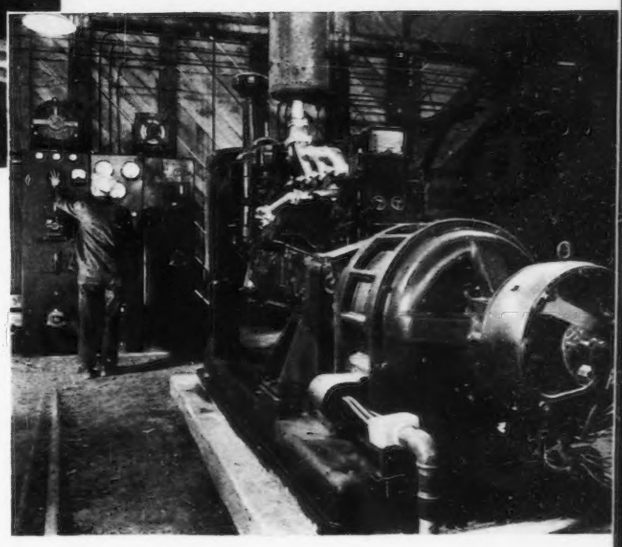
APPLIANCE AND MERCHANDISE DEPARTMENT, GENERAL ELECTRIC COMPANY, BRIDGEPORT, CONNECTICUT

TWO-OF-A-KIND AT AUSTIN NEVADA

Outdoor view at the Austin Silver Mine, at Austin, Nevada, where "Caterpillar" Diesels are providing low-cost operating-power.



D13000 with V-belt to 30-kw. generator and flat belt to Chicago Pneumatic compressor, furnishing light and power for mine, air for 4 drills. Mine engine operates up to 23 hrs. per day on 2¾ gals. of Diesel fuel per hr.



D13000 — 60-kw. generator set running part time as auxiliary and standby-power to main plant. Provides light and power for mine and mill.

DIFFERENT JOBS — but the same kind of power! These two "Caterpillar" Diesel Engines at the Austin Silver Mine in Nevada are giving the efficient service needed in isolated communities. Minimum consumption of low-cost Diesel fuel means low operating-cost. Thousands of hours of repairless operation mean extra dividends. "Caterpillar" Diesels are giving *both* these advantages in a wide variety of power applications. Ask our nearest dealer for typical examples similar to your own power needs. Or, write direct to us.

SEVEN ENGINE SIZES — 44 TO 160 HP. Sales and service everywhere.

CATERPILLAR DIESEL ENGINES

REG. U.S. PAT. OFF.

CATERPILLAR TRACTOR CO., PEORIA, ILL. . . . WORLD'S LARGEST MANUFACTURER OF DIESEL ENGINES

When a V-Belt Bends

IT Changes SHAPE

That's the REASON for the

Concave Side.

Any V-belt **changes shape** when it bends. The top is under tension and **narrows.** The bottom, under compression, **widens.** Figure 1 (below) shows the resulting shape-change in a straight-sided belt. Note the out-bulge of the sides.

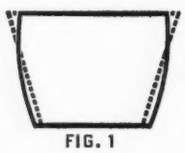
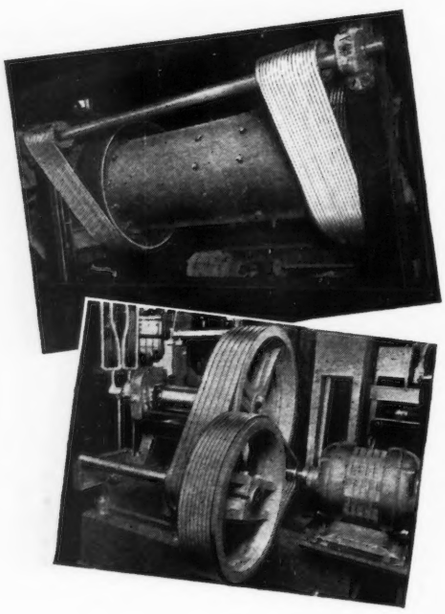


FIG. 1

WHAT HAPPENS WHEN A V-BELT **BENDS**

FIG. 2



Now look at figure 2. The same change of shape merely **straightens** the concave side, producing a contour that **precisely** fits the sheave groove.

Two big economies result: (1) No out-bulge at the side means uniform wear—**longer life!** (2) Full side-wall grip on the pulley holds heavier loads without slippage—a big increase in drive efficiency—saving belt wear and also saving **power!**

The Gates Vulco Rope is the only V-Belt built with the patented concave side.

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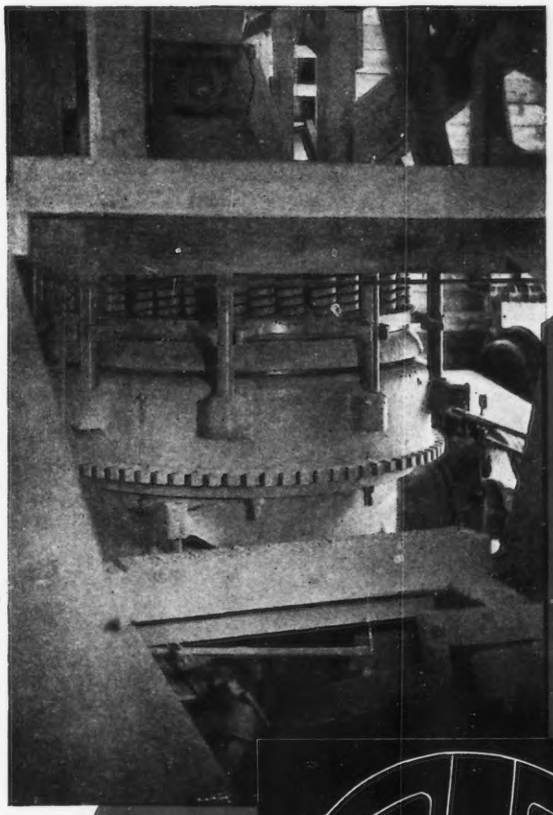
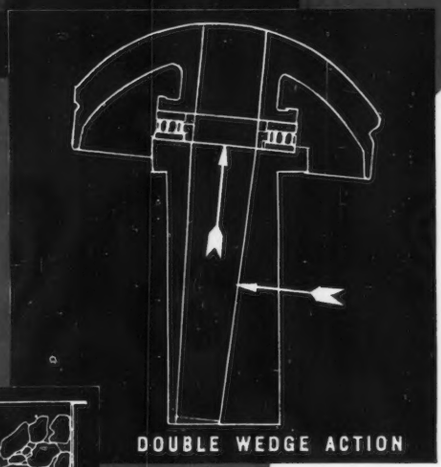
GATES VULCO ROPE DRIVES



This 48 in. Telsmith Gyrasphere Crusher crushes ore to minus ⅜ in. in the custom mill of the Cripple Creek Mining and Milling Co., Cripple Creek, Colorado.

The Only SECONDARY CRUSHER WITH THE Double Wedge CRUSHING ACTION

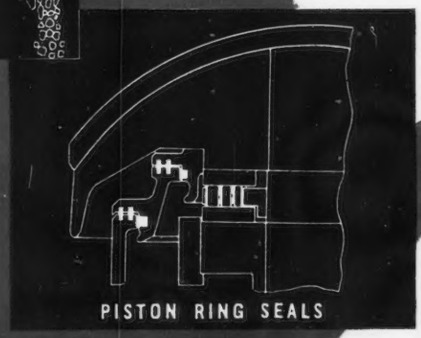


Working at choke feed, the Telsmith Gyrasphere Crusher not only turns out an enormous tonnage of more cubical aggregate, but crushes finer, with less trouble, less power, and less upkeep.

In the Gyrasphere, *two forces cooperate to produce the most effective breaking action ever developed in any crushing device.* The head is impelled both by the gyrated shaft and a rotary wedge action, produced by the supporting eccentric and roller thrust bearing. The bronze eccentric sleeves are relieved of most of the load—pressures being diverted downward to the massive roller thrust bearings which wear evenly and last indefinitely.

The Gyrasphere takes an unregulated and unlimited choke feed. That means steady, reliable, economical, effective reduction capacity.

Double protectors . . . four flexible leather labyrinth seals plus two piston rings . . . reduce both oil consumption and maintenance expense to a minimum never attained in any other crusher.



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Experienced assayers know that one of the surest ways to make close-to-perfect assays, day after day, is to use metallurgical clay goods of proved uniformity.

WRITE FOR CATALOG 13

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The product of 60 years experience.

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DFC

SALT LAKE CITY, UTAH

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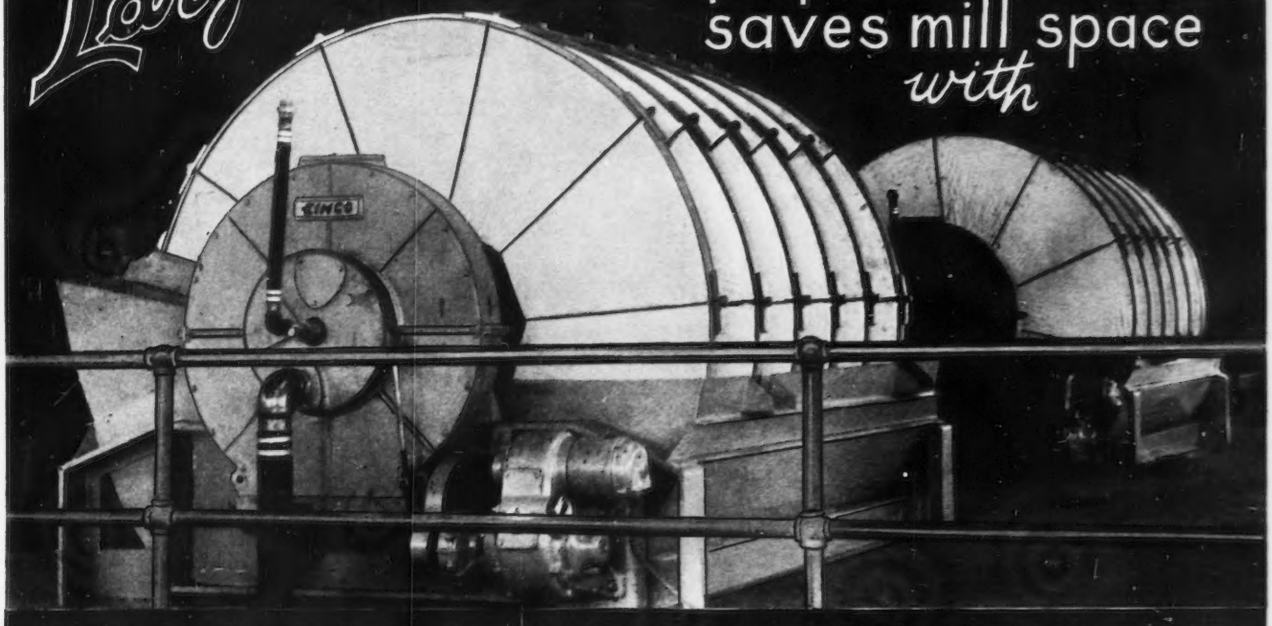
Another Large Copper Producer

overcomes varying pulp conditions... saves mill space *with*



EIMCO DISC FILTERS

● To get a uniformly low-moisture-content concentrate despite fluctuating feed in this large copper concentrator, filters were demanded that would instantly meet varying pulp conditions—yet save mill space; eliminate prolonged shutdowns and maintenance.

Eimco Filtration Engineers adapted standard EIMCO Disc Filters to the particular requirements. Infinite speed variations between 3 and 9 minutes per revolution are at the operator's command, through built-in variable speed drive, permitting disc speed variations to suit pulp characteristics. Even cake formation is assured by the baffled one-piece cylindrical filter tank with chutes for cake discharge (a patented Eimco feature).

Maximum filter capacity per sq. ft. of floor area is secured—each of these 8-ft. 6-disc, 560-sq. ft. filters requires only 120 sq. ft of floor space. Maintained efficiency and elimination of prolonged shutdown for replacement of filter cloth is assured by disc design which permits quick and easy replacement of individual sector covers with consequent savings in time and cost.

The simplicity of operation—on single or multiple product feeds—the space and time saving features of modern EIMCO Disc Filters can cut your costs too. Working with Eimco Filtration Engineers many operators have installed EIMCO DISCS to prove that they quickly pay for themselves in higher smelter returns and lower operating costs.

Why not bring your problem to EIMCO. There is no obligation. Bulletin 401 is yours for the asking.

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FINLAY AGITATORS
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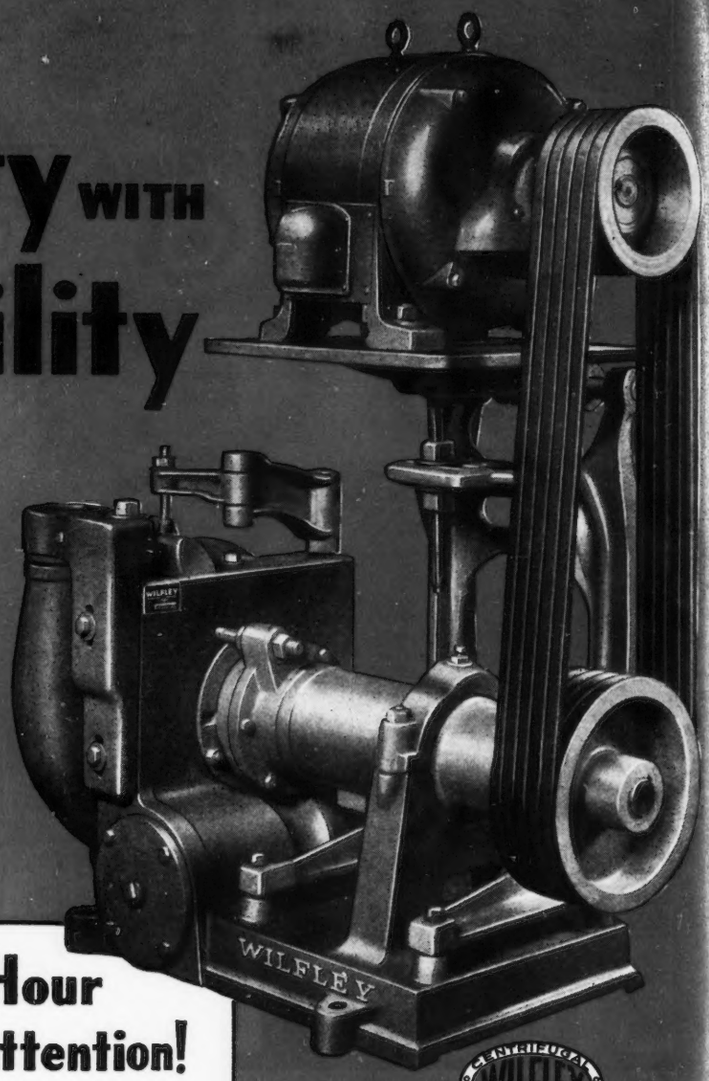

Get Continuous 24-Hour Performance *WITHOUT* attention!

Special exclusive features of design and construction enable the WILFLEY pump to deliver a kind of performance that cannot be equalled by any other pump. The Wilfley replaces uncertainty with a DEPENDABILITY that definitely reduces pumping costs.

Easy slippage seal adjustment assures close clearances and uniform efficiency. Heavy wear parts made of rubber, alloy iron, alloy steel—WHATEVER material BEST suits your particular job. Complete service by experienced engineers. Prompt shipment of parts. Write today for complete details if you want a pump that will reduce your costs and deliver continuous 24-hour service without attention.

A. R. WILFLEY & SONS, Inc., DENVER, COLO., U. S. A.

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Congress Needs YOUR Guidance....NOW

An Opportunity for the Million Readers of McGraw-Hill Publications to Help Business Recovery

TODAY, everybody sees that private industry *alone* can lead the march back to prosperous times. Business leaders, labor leaders, legislative leaders, and now the National Administration, all agree that the leadership must pass from government to private enterprise. As spokesman for the Administration, Secretary Morgenthau has said:

"The basic need today is to foster the full application of the driving force of private capital. We want to see capital go into the productive channels of private industry. We want to see private business expand."

So do we all. Nothing can take the place of expanding business. The business man needs it to meet his expenses and earn a profit. The investor needs it to put his capital to productive use. More than anyone else, the workman needs it for a steady job at regular wages. And the government needs it to get the revenues required to carry on. Everyone needs better business; there is no other way forward. But if business is to resume its leadership, government must revise its policies to make the shift possible.

Everyone who knows anything about federal taxes knows that the present system is not sound; it has been made even less so by some of the experiments of the last few years. However good those experiments may be in theory, their practical result is to frighten business men and investors from taking the risks that are necessary for business revival. As Secretary Morgenthau puts it:

"We realize that our tax laws are too complicated; we want to make them less so. We realize that there are inequalities; we want to eliminate as many of them as we can."

With this encouragement from the Administration, Congress now must get at the job. Many see the need, but it is Congress that must do something about it. What it does will depend on how it interprets the views of the people. *The time has come for the people to tell their Congress what they want.*

At no time since 1929 have business people —employers and employees— had so promising an opportunity to impress their views and their needs on the Washington government. The iron is hot; now is the time to strike!

Specifically, these three needs are urgent:

First—*Repeal the undistributed earnings tax.* As a producer of revenue it is discredited. Its chief effect has been to obstruct recovery and curtail employment by holding back the normal plant improvements by industry. Such improvements make for higher efficiency, *the only means by which consumers can get more*

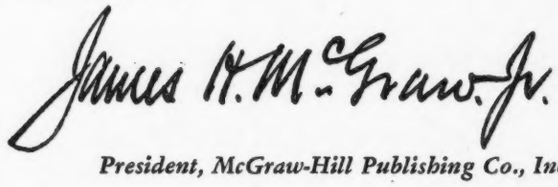
for their money, without loss of income as producers. Altogether, the undistributed earnings tax obstructs development, destroys employment, and encourages unsound financial practices. It should be repealed.

Second—*Repeal or amend the capital gains tax.* As it now stands, the investor who sells securities when prices are rising must give the government a large slice of his profit; but when he sells on a falling market he must eat his own losses. That is a one-sided, unfair proposition. It is heads-the-government-wins, tails-you-lose. It discourages the sound investment practice required by stable business. It should be repealed or amended to allow adequate deductions for losses.

Third—*Reduce the excessive personal surtaxes.* These high taxes were designed to reach for 75 per cent of the rich man's income. Whatever may be said for that objective in theory, it doesn't work in practice. It *appears* to "soak the rich" but in fact it is a blow in the air. For the rich can escape by hoarding their wealth in tax-exempt securities—municipal and government bonds rather than industrial securities. It is the latter that create productive enterprise, with orders for business and jobs for workers. So the effort to exact excessive taxes from the rich drives funds out of industrial employment and into government bonds; at the same time it dries up the source of the desired taxes. Excessive surtaxes are a good example of losing all by over-reaching; they should be amended to encourage enterprise and increase revenues.

The America of today is possessed of the same driving force that created it. All it asks is a chance to resume its progress. In the early days of our national development, government paid huge bounties to encourage private construction of the railroads. Today industry asks no bounties; it asks only a chance to invest in national progress the surplus wealth that it has itself created. It is willing to meet the increased obligations of social progress and to pay its share of the governmental costs, but it asks relief from the shackles of restrictive and confiscatory taxation. It is ready to resume its interrupted march toward restored prosperity if only Congress will loosen the bonds that now confine it. Only Congress can effect that release. It can do so only by revising restrictive taxation. And only the American people can prevail upon Congress to meet that appeal *and to meet it NOW.*

Congress needs *YOUR* guidance. Will you give it *NOW?*



President, McGraw-Hill Publishing Co., Inc.

If private capital and business initiative are to take a leading role in recovery—then it is the obligation of the business and technical press to study ways and means by which this is possible; to keep business and industry currently informed; to mobilize opinion and to make that opinion felt and understood by the government, which has the power to obstruct or to encourage business and industrial progress. The McGraw-Hill Publications recognize that obligation. We are seeking in this editorial effort to provide an avenue through which our one million readers—America's business and industrial leaders—may indicate to the Congress the need to change the tax system so that industry can move forward more surely and rapidly.

USE THESE CARDS...*NOW!*

To encourage Congress to revise taxes NOW

To secure extra copies of this editorial

To get a comprehensive analysis of taxes

To encourage Congress to act now along the lines of this editorial, send in one of the cards below—now. Studies have shown that an average of 4 persons read each copy of this publication—so four cards are here provided—one for each reader.

Extra copies of this editorial are available for you—at cost—should you desire to put this into the hands of your associates, employees or friends. You may order these on the card below, too.

Business Week is publishing in one of its December issues a comprehensive analysis of the tax situation. You may secure a free copy of this analysis by checking and mailing the card below.

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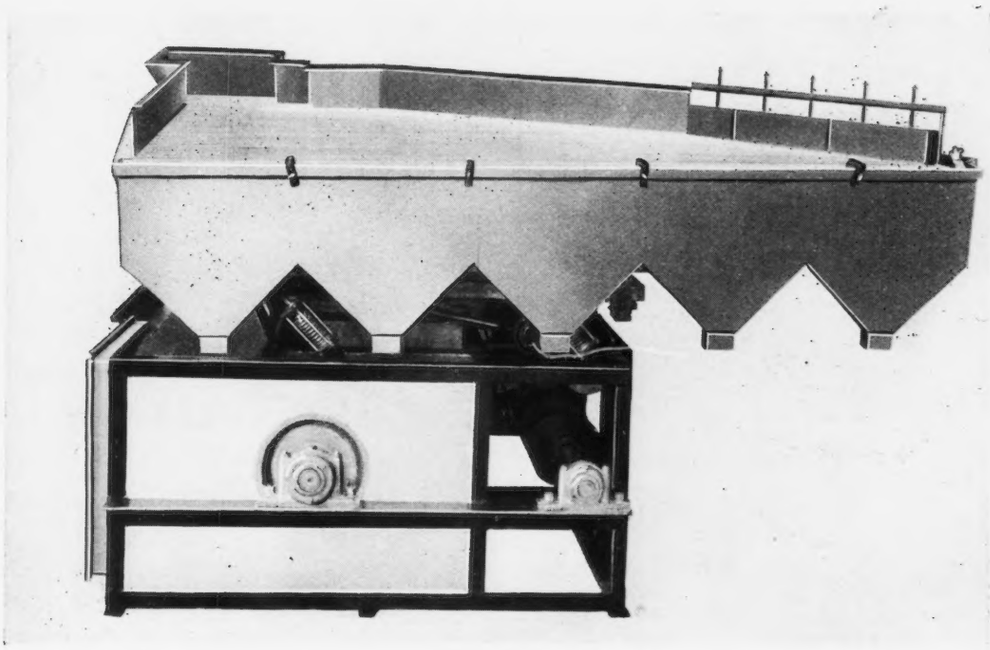

Recent improvements have made commercially profitable the application of a proven process, and today successful operators are using AIR FLOTATION for the concentration of such minerals as:

PYRITE	GALENA	KYANITE
PYRRHOTITE	BLENDE	ILMENITE
MAGNETITE	MICA	GARNET
SCHEELITE	VERMICULITE	ZIRCON, Etc.

If the materials you would like to separate have a difference in specific gravity or even in particle shape it will pay you to investigate "AIR FLOTATION" both as to performance and cost of operation. We will gladly and without obligation submit our recommendations if you will send us a suitable sample of your product for a laboratory test run.

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It has such an abundance of graphite-grease lubricant that it not only saves the shaft and prolongs the life of the packing, but enables the pump to develop its full efficiency.

"PALCO" will not damage pump shafts. Made of selected cotton of great tensile strength. Lubricated in each single strand before plaiting. For centrifugal, reciprocating and mine pumps. Keeps water in—keep air out. Will not score the shaft of a centrifugal pump traveling at high speed. Not affected by feed-water treating compounds.

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An ideal packing for Steam (high pressure, superheated) and Compressed Air. "PALMETTO" is made of the highest grade of asbestos that does not require cotton, rubber or wire to hold it together, and is therefore heat-proof, and so perfectly lubricated in each single strand it does not harden in service.

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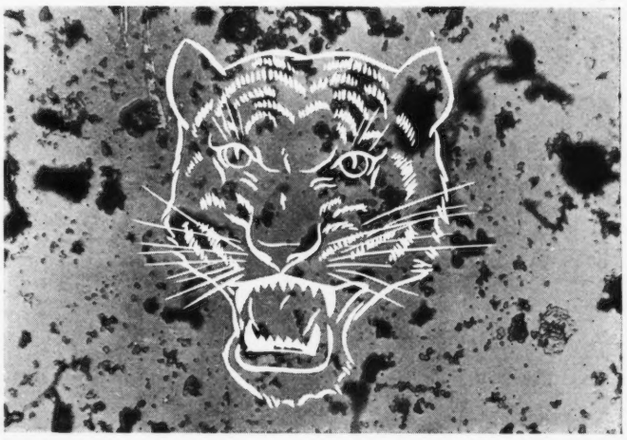

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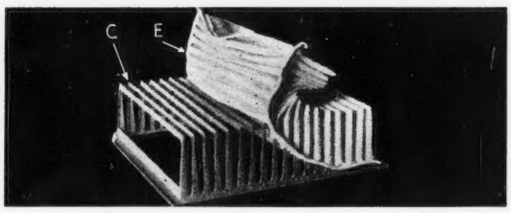

(C) — Wide pocket areas, no clogging — skyscraper frame, no wires.
(E) — Dry type, no oil. Note minimum welds, no breaks.

Write Coppus Engineering Corporation, 368 Park Ave., Worcester, Mass. *for Bulletin F-310-3. Other products, mine ventilation blowers, in METAL QUARRIES CATALOG.*

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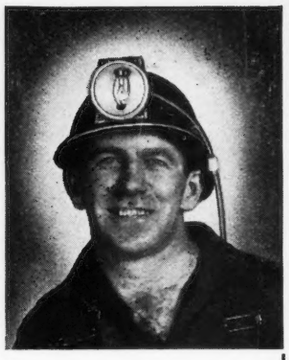

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The new model WHEAT delivers 52% MORE LIGHT than the next brightest electric cap lamp—300% MORE LIGHT than any open-flame lamp. This greater volume of bright light is a factor that helps produce greater tonnage per man-day—fewer accidents, lower compensation costs.

It is another reason why so many representative mine operators have changed to WHEAT Electric Cap Lamps after critical comparisons with other makes.

Moreover—

WHEAT Light Does Not Fade or Flicker

It is practically as bright when the miner stops work as when he starts. Scientific tests have demonstrated that the WHEAT Cap Lamp *maintains* a voltage discharge efficiency averaging 95.9% at the working face throughout the shift.

WHEAT delivers STEADY bright light *all the time*. No fading, no flickering, no time out, as with open-flame lamps. The result is greater efficiency, less fatigue for the miner. Hence greater production—less accidents.

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Please send full information on the WHEAT Electric Cap Lamp, without obligation on my part.

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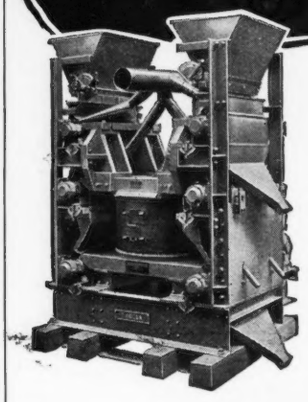

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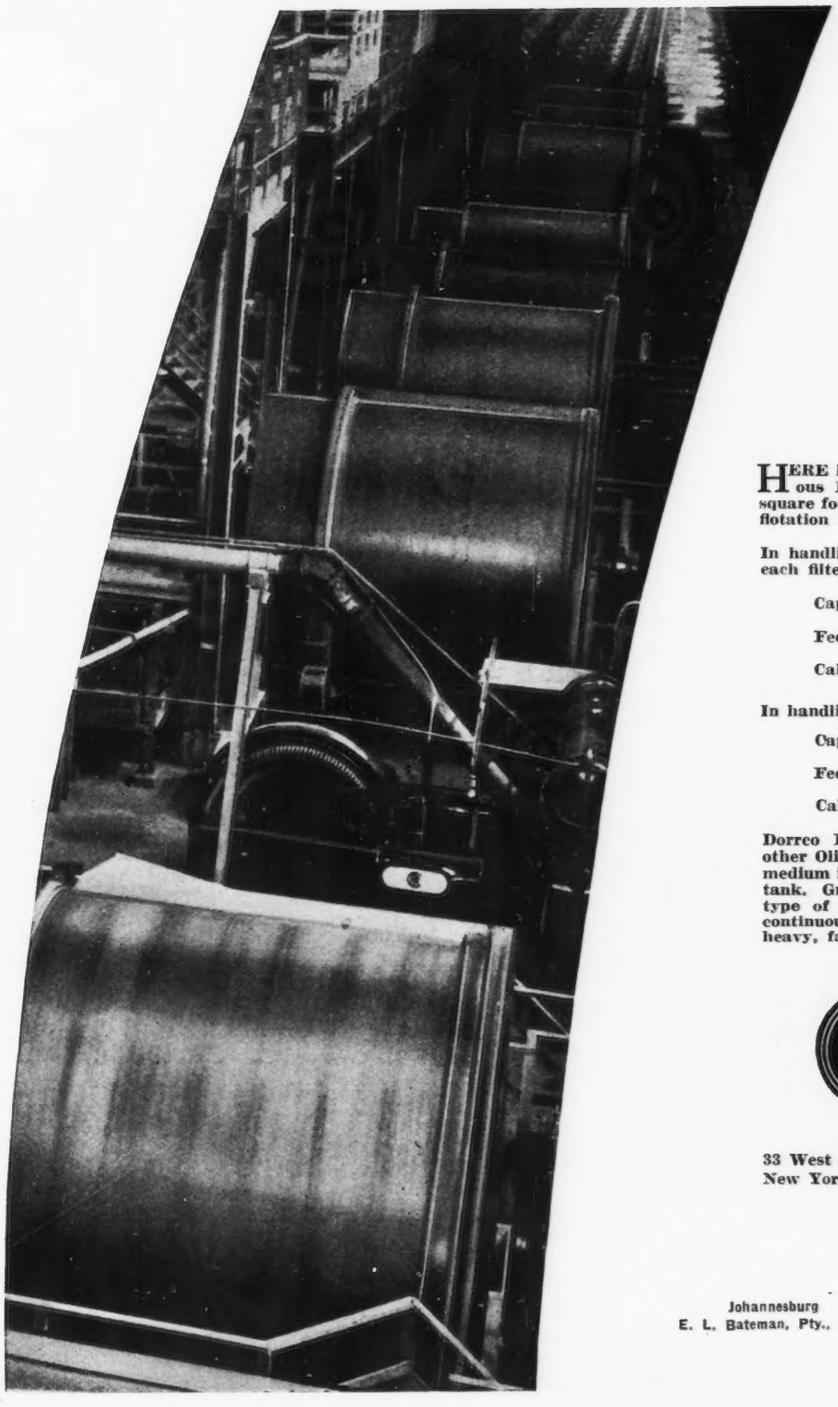

HERE is one of the best installations of Dorrco Continuous Filters in the entire mining industry. Nine 700 square foot units are used for dewatering nickel and copper flotation concentrates.

In handling nickel, the following are typical results from each filter:

Capacity	750 to 900 tons per 24 hours or better than 1 ton per sq. ft.
Feed	30% moisture with 65% through 200 mesh.
Cake	11% moisture.

In handling copper:

Capacity	700 to 800 tons per 24 hours or about 1 ton per sq. ft.
Feed	33% moisture with 70% through 200 mesh.
Cake	9% moisture.

Dorrco Filters differ from Olivers and Americans (the other Oliver United Continuous filters) in that the filtering medium is on the inside of the drum which acts as its own tank. Gravity aids the vacuum in forming a cake. This type of filter is particularly well-adapted for handling continuously and automatically pulps or slurries containing heavy, fast-settling solids.

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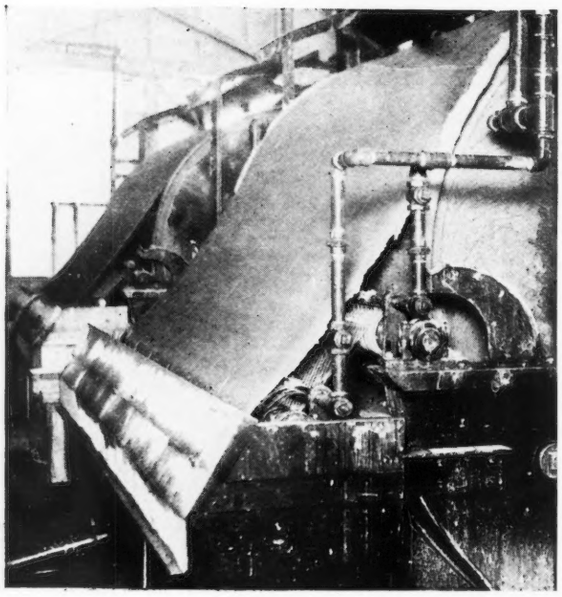

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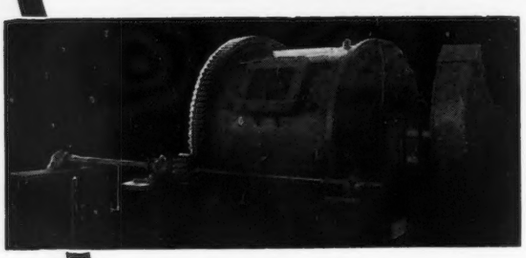

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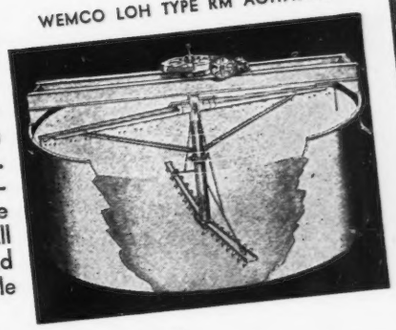

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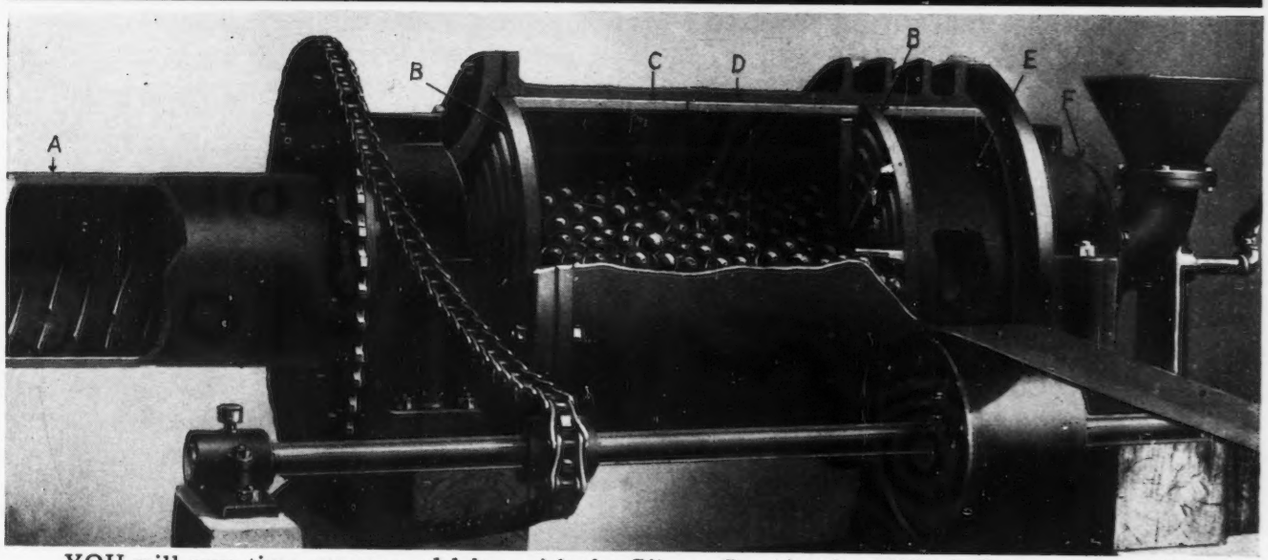

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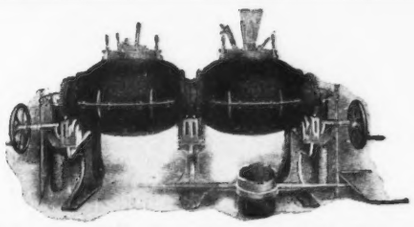

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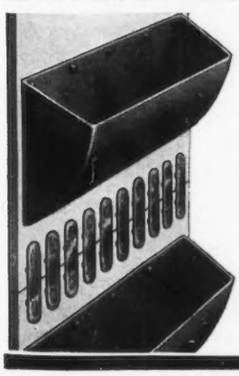

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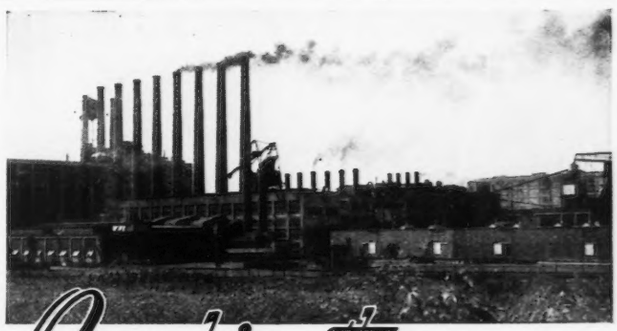

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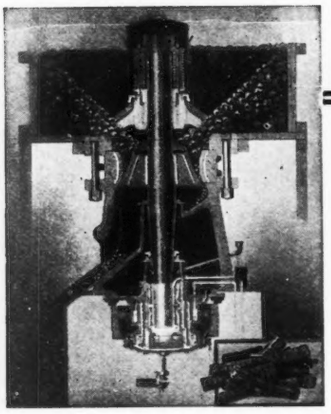

Kennedy BALL BEARING GEARLESS CRUSHERS

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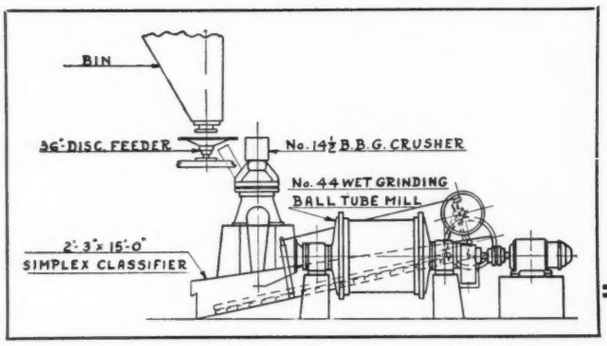

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Unique features of design are responsible for the savings in power and maintenance and the remarkable capacity assured by the Kennedy Ball Bearing Gearless Crusher.

Size for size this crusher has proved itself capable of handling greater tonnage than any other at half the power per ton of ore.

Elimination of gears vastly reduces power requirements. A self-aligning ball-and-socket eccentric provides for faster speeds of crushing blows and thereby increases capacity. By the use of a disc feeder for regulating the quantities through the crusher, classifier and gearless ball mill, customers report increasing the capacity from 46% to 100%.

Let our engineers give you an estimate of the savings you can make with this modern, high-capacity crusher. Send us samples of your ore. Let us help you.

KENNEDY-VAN SAUN MFG. & ENG. CORP.
2 PARK AVE., NEW YORK, N. Y.

HENDY PRODUCTS

. . . . give the low-cost service that produces profits for you.

HENDY builds—*for Lode Mining*: Crushers, Feeders, Ball Mills, Flotation Machines, Cyanidation and Amalgamation Equipment. Hoists, Headframes, Sheaves, Skips, Cages Safety Crossheads, Dumping Irons.

Mine Cars in several types and sizes.

For Placer Mining: Hydraulic Giants, Gravel Elevators, Water Lifters, Waterwheels, Derricks, Clean-up equipment. Dredge Machinery.

Send for Bulletin 204 or Special Bulletins on the Machinery you need.

JOSHUA HENDY IRON WORKS SINCE 1850 SAN FRANCISCO, CAL.

JOSHUA HENDY IRON WORKS
Sales Office: 206 Sansome Street, San Francisco
Plant: Sunnyvale, California. Cable Address: HENDY

RELIABLE—DEPENDABLE—ECONOMICAL

Today High-Speed Haulage makes it necessary to have smooth, evenly curved and properly joined trackage. UMECO Tools not only accomplish this, but are easily handled and carried swiftly from place to place by one man, and also, safety is promoted when good track construction is made faster and easier.

UMECO Light Weight Tools are needed by your track layers.

Write today for full particulars.

UTILITY MINE EQUIPMENT COMPANY
620-30 TOWER GROVE AVE. ST. LOUIS, MO.

Flotation Oils, including

G.N.S. No. 5 Pine Oil

Long the Standard Frothing Oil

Stocks in principal distributing centers

General Naval Stores Co.

230 Park Ave., New York, N. Y., U.S.A. Cable Genstors

AUXILIARY VENTILATION

MineVent
FLEXIBLE

BLOWER PIPE

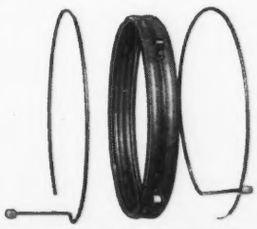
This durable, waterproof tubing is solving auxiliary ventilation problems in the metal mines of many countries.

It ventilates working places beyond permanent air, effectively and at small cost.

Attaches to standard blower. Terminal section folds back for blasting. Tubing is quickly installed or reclaimed by unskilled labor.

Patented, air tight coupling permits use of odd lengths. . . . saves material and installation time. The simplest, most dependable coupling for blower pipe.

Write for literature and prices.



MINE-VENT COUPLING saves you money.

Mfrs. of ABC Brattice Cloth and Mine-Vent Powder Bags

AMERICAN BRATTICE CLOTH CORP.
WARSAW, IND., U.S.A.

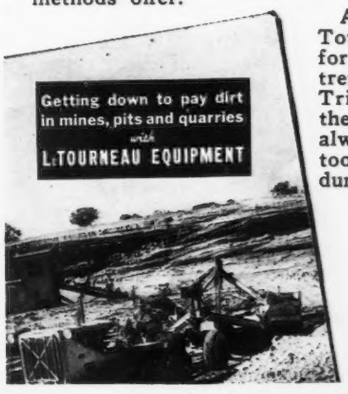
RIPPING hard shale with LeTourneau Rooter. Note Bulldozer in high lift position, until needed for part in materials moving.

SIDECASTING part of previous Scraper load with the Angledozer, controlled by front end Power Control Unit; leaving rear Unit free for operation of Carryall Scraper

Every Mine Should Have AT LEAST ONE LeTOURNEAU COMBINATION

We beg your pardon; we thought you had been told that any LeTourneau tractor equipment could be worked *profitably* in combination for mining work. For instance: the tractor that keeps stock piles so well in hand with the Bulldozer, will also rip virgin ore and up-root boulders of unbelievable size with a Rooter in combination. The LeTourneau Carryall that has cut costs in two by digging and transporting its own material over long and short hauls, may be worked in combination with a Bulldozer or Angledozer for end dump fills.

The LeTourneau principle of cable control makes your tractor a versatile power plant. Each LeTourneau unit is adapted quickly and simply—ready to do any job assigned—cheaper and more thoroughly than other methods offer.



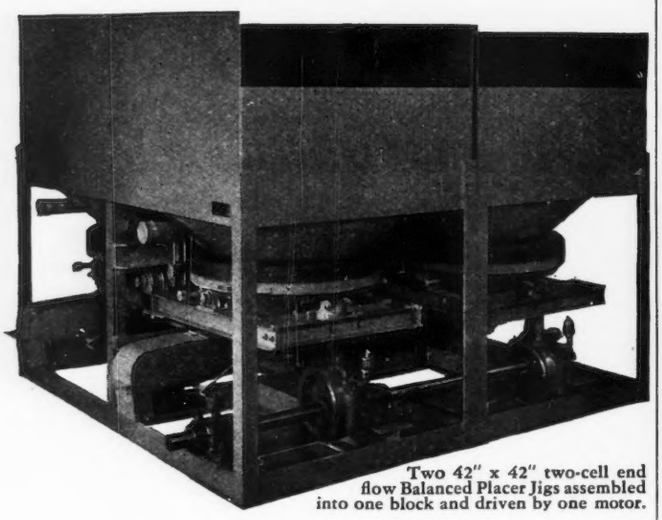
Another advantage is LeTourneau's all-weather performance—unaffected by extreme heat or sub-zero cold. Trigger-quick response at the blade; brute strength always is yours with these tools in the mine, on the dump or at the spoil bank.

WRITE for the folder "Getting Down to Pay Dirt in Mines, Pits and Quarries." Then, submit YOUR problem to the Field Engineering Department. Their Job-Proved, practical suggestions will save you money.

R. G. LeTOURNEAU, INC.
Peoria, Illinois **Stockton, California**
Cable Address: "Bobletorno"
Manufacturers of: Angledozers*, Buggies*, Bulldozers, Carryall* Scrapers, Cranes, Drag Scrapers, Rooters*, Power Control Units, Treedozers
*Name registered U. S. Patent Office

LeTOURNEAU

Now—
The BALANCED PLACER JIG
by PAN-AMERICAN ENGINEERING CO.



Two 42" x 42" two-cell end flow Balanced Placer Jigs assembled into one block and driven by one motor.

for Small Dredges with Low Head Room . . .

This Balanced Placer Jig is an improvement for boats lacking head room for a standard size jig. Two bucket line dredges are already operating successfully, completely equipped with units of this Jig as the only gold saving devices used.

Height from discharge lip to base is 12" less than on the standard Pan-American Placer Jig, other over-all dimensions remaining the same. Also, the Balanced Placer Jig operates with somewhat less power than is required for the standard Placer Jig.

Available in 2-cell units, for either cross-flow or end-flow. Send for details, giving information on your present flowsheet.

PAN-AMERICAN ENGINEERING COMPANY

820 Parker Street Berkeley, California, U.S.A.
Cables: "PANCO"

Precision Filtering
WITH

Precision Fabrics

Whether your task is one of concentrating slimes or filtering pregnant solutions—filtering that is associated either with clarification or precipitation—the efficiency of the operation depends largely upon the uniformity of the filter fabric used.

Every square inch of each MT. VERNON EXTRA fabric tests to such a remarkable degree of uniformity with every other square inch of the same construction that they may rightly be called precision fabrics. Woven on the finest modern looms from yarns that are tested to micrometric tolerances, their whole production is guided by more than half a century's experience.

To secure maximum efficiency in each filtration process first determine what construction is best adapted to that particular need, then specify it—MT. VERNON EXTRA.

MT. VERNON-WOODBERRY MILLS, INC.
TURNER HALSEY COMPANY
40 WORTH STREET *Selling Agents* NEW YORK CITY
Branch Offices: SAN FRANCISCO · NEW ORLEANS · CHICAGO · BOSTON · BALTIMORE

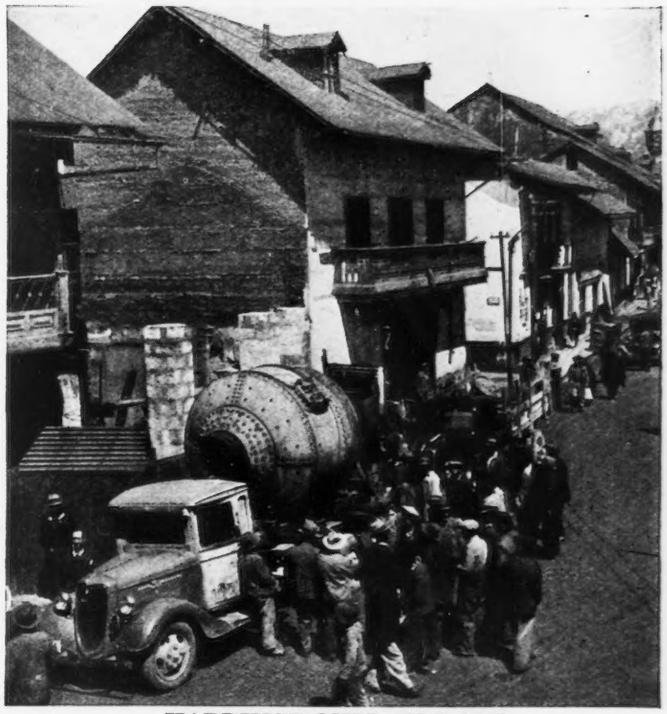
HARDINGE

Serves the WORLD

MEN in foreign countries can't afford to take chances. That's why they use Hardinge Mills. A Mill that serves the World *can do your job!*

The truss-like construction of the Hardinge Conical Mill means less weight and greater strength—a reduction in dead weight load, resulting in less friction loss and savings in power, and smaller upkeep costs, because their cone shape reduces Ball and Liner consumption. Write for descriptive Bulletin—today.

HARDINGE COMPANY
INCORPORATED
YORK, PA., Main Office and Works
New York, 122 E. 42nd St.; Chicago, 205 W. Wacker Drive
San Francisco, 501 Howard St.; Denver, 817 17th St.



HARDINGE MILL IN PERU

GECO

A Complete Service for Mining Companies with Milling Problems

Backed by more than thirty years' successful experience in solving metallurgical problems throughout the world—GECO Service starts with unsurpassed ore testing and experimental laboratory facilities, which enable us to determine definitely what methods and equipment will best produce the required results. If desired we then assume entire responsibility for design, construction, equipment and successful operation. We also manufacture advanced types of Flotation Machines, Filters, Samplers, and Laboratory Equipment. Write us regarding your milling conditions and requirements.

THE GENERAL ENGINEERING COMPANY
159 Pierpont St. Salt Lake City, Utah
Toronto New York City London

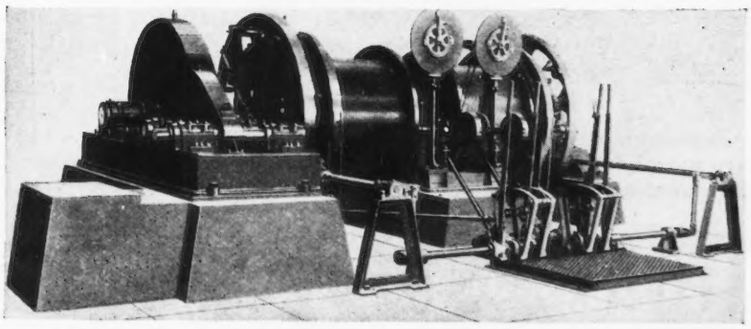
The "YARD STICK" in gauging FINE TABLES

The DEISTER CONCENTRATOR COMPANY

"The Original Deister Company"
Incorporated 1906
903 Glasgow Ave., Ft. Wayne, Ind.

In comparisons of costs and performance the standard equipment in concentration is the Deister-Overstrom Diagonal Deck Table. With this table you are guaranteed the highest degree of metallurgical efficiency at lowest cost.

ELECTRIC MINE HOISTS



- Any Capacity
- Hand or Oil Operated Post Brakes and Clutches with Lilly Safety Control

Illustrated at left is 100 H.P. Double Drum Mine Hoist built for the North Cararines Gold Mining Company, Philippine Islands.

WASHINGTON IRON WORKS
SEATTLE, U.S.A.
The Edward J. Nell Co., Representatives, Manila

CALMIX CUPELS

for efficiency economy and convenience

BRAUN CALMIX CUPELS:

- **Reduce cupellation losses.**
- **Absorb more lead than bone ash.**
- **Respond quickly to temperature regulation.**
- **Will not crack or check in the muffle.**
- **Need no initial drying.**
- **Uniform performance.**

Write for literature. Address Dep't. E-12.

BRAUN CORPORATION

2260 East Fifteenth Street, Los Angeles, California
San Francisco, Calif. — Seattle, Washington
BRAUN-KNECHT-HEIMANN CO. — SCIENTIFIC SUPPLIES CO.

Long Range Machines

Slacklines and Drag Scrapers

Low First Cost and Low Operating Cost

Hourly Handling Capacities: 10 to 800 cu.yd.

Spans up to 1500 ft.

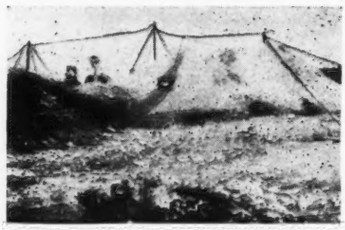
Suited to handling Clay, Gravel, Loam, Sludge, Ores, Coal, Tailings, etc.

Sauerman Slackline—

the ideal device for moving materials from a stream or pit to an elevated receiving point.

Write for Catalog

SAUERMAN BROS.
484 S. Clinton St., Chicago



Crescent Dragline Scraper—

a money-saver for working dry ground, reclaiming tailings, stripping overburden.

What the "SEARCHLIGHT" "Spotted" for readers of the Engineering and Mining Journal in 1936

Over 400 advertisements featuring Employment, Equipment and Business Opportunities of interest to the metal mining industry were published during 1936. They included:

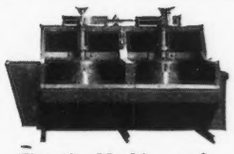
Over 40 pages listing thousands of items of Used Mine, Mill, Smelter and Power Equipment for sale, offered by dealers, mines and other owners; also advertisements of equipment wanted.

Over 100 advertisements of Employment Offered or Wanted for technical and skilled men in executive, operating or sales positions.

Over 120 advertisements of Business Opportunities covering gold, silver, copper, quicksilver, nickel, diamond, lead and other mines or properties for sale, lease or wanted; special ores for sale; residues or concentrates; semi-precious stones wanted; capital offered and wanted; organizing and other special services offered, etc., etc., etc.

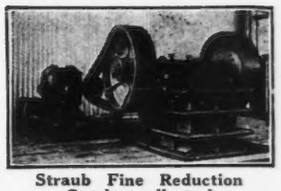
Some of the advertisements summarized above may have been of special interest to *you*. Other readers may be interested in *your* advertisement of a *present* business need or "opportunity" of like character.

Can "Searchlight" Serve You?

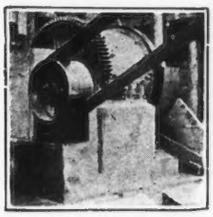


Flotation Machines and Mineral Jigs

STRAUB'S COMPLETE SERVICE



Straub Fine Reduction Crusher, all-steel



Rib-cone Screening Mill, without external classifier, milling 50 tons per day to 30 mesh. Delivers a sharp sandy slime-free product, ideal for amalgamation and concentration.

CONSULTATION
Consultation and advice regarding your milling problems.

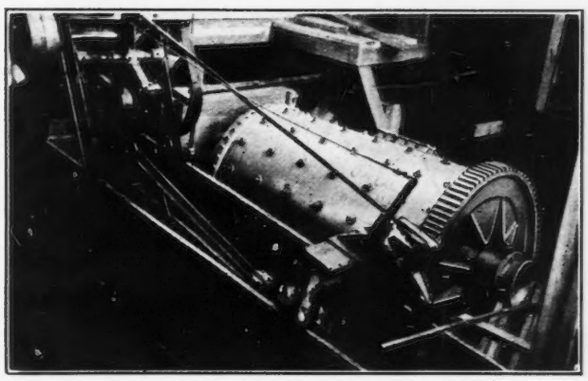
ORE TESTING
Ore testing facilities, if such work is needed on your samples.

PLANT DESIGN
Complete layout of a plant to suit your conditions and ores.

MANUFACTURE
We make and furnish everything to make up a balanced plant.

DELIVERY
Guaranteed delivery on or before the promised date.

PURCHASING
We act as buyers and purchasing agents for many mines.



Rib-cone all-steel Ball Mill, grinding to 150 mesh in closed circuit with external rake classifier. 70 sizes of mills made, in sizes from 2 to 500 ton units. Standard or Sectional. Prices start at $220.

We build the Overstrom Universal Concentration, favorably known in the mining world for clean, high grade concentrates, lean tailings, high capacity, low power and water consumption—5 standard sizes available.

Descriptive Catalog Will Be Gladly Sent
Pidanos Catalogo Espanol

STRAUB MFG. CO.

567 CHESTNUT ST. OAKLAND, CALIF.

Also built in Canada by Canadian Straub Ltd., 1188 Phillips Place, Montreal

SAFETY DEVICES

—FOR ACCIDENT PREVENTION AND EMERGENCY WORK!

Many mines thruout the country are using the safety devices below for effective personal protection of miners. Each device is dependable and proven in use.

RESPIRATORS
for Dusts, Fumes, etc.
GAS MASKS
KNEE GUARDS
All-rubber cushion
SAFETY HATS
SAFETY GOGGLES
SAFETY SHOES
TOE GUARDS

Write us for details and prices on any of these safety items.

PULMOSAN SAFETY EQUIPMENT CORP.,

Dept. EM, 176 Johnson St., Brooklyn, N. Y.

Assure better performance through

EFFICIENCY

In the Nichols Herreshoff Multiple Hearth Furnace, efficiency in direct heat transfer is achieved through a system of rabbling which provides maximum material surface exposed to furnace gases.

Lower operating costs in roasting, calcining and drying of many materials are direct results of the high performance efficiency of these furnaces. Thousands of furnaces now in operation throughout the world bear testimony to the popularity of the Nichols Herreshoff method of multiple hearth roasting.

Economy is assured also by:

Flexibility
Adaptability
Low Maintenance
Low Power Requirements
Minimum Floor Space

Write for details

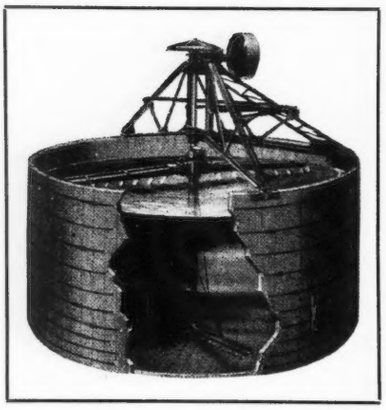
NICHOLS ENGINEERING & RESEARCH CORP.
40 Wall St., New York, N. Y.
PACIFIC FOUNDRY COMPANY, LTD.
3100 19th St., San Francisco, Calif.

NICHOLS HERRESHOFF FURNACES

AGITATORS and THICKENERS

New Standard Types—at prices which mean a great saving to you

(GET OUR ESTIMATES—THEY WILL INTEREST YOU)



AGITATORS—as shown in cut or with Low-Head Superstructures and steel tanks (all sizes up to 40′ dia.)

THICKENERS—any size up to 80′ dia. with Redwood, Fir or Steel Tanks. Steel Superstructures if desired—Low-head, Type "A" or Bridge Type.

MOTORS and DRIVES—Gear motors and V-belt Drives built in with all sizes of Agitators and Thickeners furnished when desired.

Our manufactured products include

Agitators
Ball Mills
Classifiers
Crushers
Conditioners
Diaphragm Pumps
Feeders
Filters
Furnaces
Samplers
Screens
Thickeners
Weinig Flotation Machines
Precipitation Equipment
Wood and Steel Tanks

MORSE BROS. MACHINERY CO.

2900 Broadway DENVER, COLO., U. S. A. P. O. Box 1708

TRUSTEE'S SALE

Real Estate and Leasehold Interest
Stock, Machinery and Equipment of

ANNANDALE GRAPHITE CORP'N

ANNANDALE, CLINTON TWP., HUNTERDON CO., N. J.

On Main Line of Central R. R. of N. J.

To Be Sold at Auction

TUESDAY, DECEMBER 28, 1937 AT 12 NOON, ON THE PREMISES

REAL ESTATE: Timber Manufacturing Building, Warehouse, etc on Case Farm, 135 Acres with dwellings and farm buildings; Freeh Farm adjoining 34 Acres; Also Apgard Farm, 90 Acres with houses and buildings.

STOCK: 24,000 lbs. of refined flake Graphite 93 to 97% C.

MACHINERY AND EQUIPMENT: 3 Traylor and Buchanan 10x16 in. jar type Ore Crushers; 2 Traylor 14x30 in. double roll Crusher Rolls; 2 Marcy 2x4 rod and Hardinge 30 in. conical ball Roller Mills; Type A1804 and A1808 Flotation Machines; 3 Dorr and Caldwell 6x6 and 8x11 Thickener Tanks with Agitators; 2 Hummer single and double 2 and 3 deck Vibrating Screens; Wood Frame Vibrating Screens; 5 Six Roll Three Tier 10x45 in. Finishing Rolls; Oliver Filter and Christy Dryer Unit comprising Oliver Filter, Centrifugal and Vacuum Pumps with Reeves transmissions and motors, Christy rotary dryer, with Reeves transmission and motors. Ray Oil Burner, 2 American blowers with motors and Brown electric pyrometer and recorder; Lidgerwood single drum 26x40 in. Hoist with Burke 75 HP AC motors and controls; Lidgerwood single drum 36x48 in. hoist, rope pull 4200 lbs. complete with Lilly hoist control and G.E. 60-20 HP intermittent induction motor and controls; Oliver, Cameron and Gould Vacuum and Centrifugal Pumps G. E., Westinghouse and Burke A. C. induction and synchronous constant speed, constant varying and intermittent speed electric motors from 2 to 100 HP, 220 V. 60 C. 3 Ph; Westinghouse automatic starters, 3 AC and DC motor generator sets. 100 ft. all steel bucket type floor conveyor, canvas belt conveyor, vises, electrical equipment, railroad track, steel shafting with pulleys and hangers, large quantity leather and canvas belting, office furniture, etc.

Descriptive Catalogs upon Application to

SAMUEL T. FREEMAN & CO., *Auctioneers*

1808–10 Chestnut Street, Philadelphia

27 William St., New York **80 Federal St., Boston**

Increased TONNAGE! Extra PROFITS!

with GUARANTEED RECONDITIONED MACHINERY

MINING AND MILLING

Quick shipment is assured whether it is an individual machine or a complete plant.

ELECTRIC MINE HOISTS

SINGLE DRUM

2—10-hp. Boxco, friction drive
2—15-hp. Vulcan Iron Works
14—20-hp. Vulcan Iron Works
2—30-hp. Vulcan Iron Works
3—40-hp. Vulcan Iron Works
3—50-hp. Vulcan Iron Works
2—75-hp. Vulcan Iron Works
4—100-hp. Vulcan Iron Works
1—150-hp. Lidgerwood
2—200-hp. Lidgerwood
All above Hoists are complete with Motors with drum controls and resistance.

ELECTRIC MINE HOISTS

DOUBLE DRUM

1—100-hp. Angels Iron Works
2—100-hp. Denver Engineering Works
1—150-hp. Denver Engineering Works
1—200-hp. Nelsonville
1—300-hp. Webster-Camp & Lane
All above Hoists are complete with Motors with drum controls and resistance.

GASOLINE HOISTS

1—40-hp. Novo, double Tandem Drums
1—35-hp. Novo, Double Tandem Drums
1—25-hp. Fairbanks-Morse, Single Drum
1—25-hp. Witte, Single Drum
1—25-hp. Vulcan, Single Drum
4—20-hp. Vulcan, Single Drum
1— 8-hp. Novo, Single Drum

LOCOMOTIVES

TROLLEY TYPE

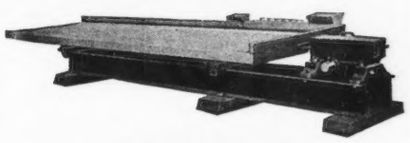
2—8 Ton General Electric, 250 volt
4—7 Ton General Electric, 250 volt
4—4 Ton Goodman, 250 volt
1—3½ Ton Baldwin, 250 volt

BATTERY TYPE

2—6 Ton Goodman
8—5 Ton General Electric
1—3½ Ton Atlas
1—Mancha Little Trammer
1—4 Ton Plymouth, gasoline

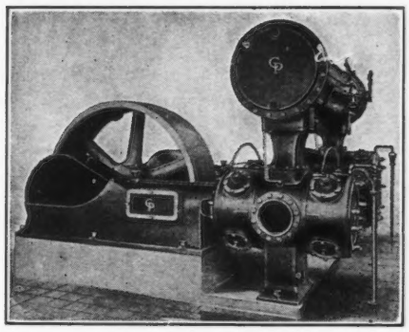
ORE CARS

14—12 cu.ft. Standard, 18" gauge, Timken Bearings
20—16 cu.ft. Standard, 18" gauge, Timken Bearings
12—20 cu.ft. Standard, 18" gauge, Timken Bearings
5—27 cu.ft. Truax, 24" gauge
7—28 cu.ft. Truax, 18" gauge
4—30 cu.ft. Truax, 18" gauge
1—41 cu.ft. Granby, 30" gauge
2—82 cu.ft. Granby, 30" gauge
28—50 cu.ft. Koppel, 24" gauge



CONCENTRATING TABLES

46—No. 6 Wilfley, Steel Underframes, Enclosed Head Motions. Can also be furnished with 1½-hp. motors and V-belt drives.
32—No. 11D. Wilfley, Enclosed Head Motion
8—No. 9, Wilfley, Double Deck, Steel Underframes, Extra Heavy Head Motions



AIR COMPRESSORS

TWO STAGE

2—1100 cu.ft. Ingersoll-Rand, belt driven
1—922 cu.ft. Chicago Pneumatic
2—800 cu.ft. Ingersoll-Rand
2—585 cu.ft. Ingersoll-Rand
1—455 cu.ft. Sullivan, Angle Compound
1—450 cu.ft. Ingersoll-Rand
1—350 cu.ft. Ingersoll-Rand
1—293 cu.ft. Ingersoll-Rand
1—215 cu.ft. Ingersoll-Rand

AIR COMPRESSORS

SINGLE STAGE

2—375 cu.ft. Ingersoll-Rand
1—360 cu.ft. Ingersoll-Rand
1—300 cu.ft. Sullivan
1—275 cu ft. Ingersoll-Rand
1—235 cu.ft. Bury

PORTABLE COMPRESSORS

2—320 cu.ft. Westinghouse National
2—310 cu.ft. Ingersoll-Rand
1—167 cu.ft. Gardner-Denver

DRILLS

10—No. 93 Gardner-Denver Jackhammers
2—No. 11 Gardner-Denver Jackhammers
3—No. 50 Gardner-Denver Jackhammers
4—S-49 Ingersoll-Rand Jackhammers
41—CCW-11 Ingersoll-Rand Stopers
11—16W Gardner-Denver Stopers
10—17W Gardner-Denver Stopers
24—No. 17 Gardner-Denver Drifters
8—No. 21 Gardner-Denver Drifters
8—No. 60 Gardner-Denver Drifters
6—No. 107 Gardner-Denver Drifters
17—N-72 Ingersoll-Rand Drifters
19—R-72 Ingersoll-Rand Drifters
13—No. 80 Worthington Drifters

DRILL SHARPENERS

5—No. 33 Ingersoll-Rand
3—No. 34 Ingersoll-Rand
3—No. 5 Ingersoll-Rand
2—No. 50 Ingersoll-Rand
1—Class A Sullivan
Complete sets of dies and dollies for above.

LABORATORY EQUIPMENT

CRUSHERS

3—4-in.x6-in. Universal Type
6—2¼-in.x3½-in. Universal Type
2—10-in.x4-in. Blake Type
3—5-in.x7-in. Dodge Type

SMELTING FURNACE

1—42"x120" Traylor Blast Furnace. Steel Jacketed Type—Never Used. Complete with Blower and Accessories.

HIGH HEAD MINE PUMPS

2—6" Cameron 6-stage Mine Pumps, capacity 1100 g.p.m. 1150' head direct connected to 500 HP. G.E. Motors, 3 ph. 60 cy. 2200 Volt, 1800 R.P.M.

2—6" Worthington 6-stage Mine Pumps, capacity 1200 g.p.m. 850' head direct connected to 500 H.P. G.E. Motors, 3 ph. 60 cy. 2200 Volt, 188 R.P.M.

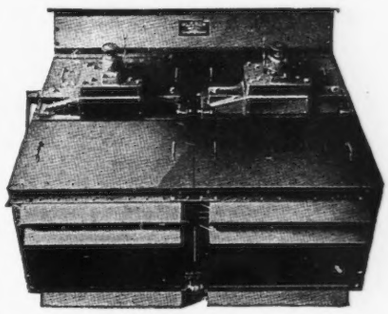
Send for our Pump Stock List.

PULVERIZERS

8—8-in. Braun Disc Pulverizers
3—No. 1. Ring & Cone Grinders
4—No. 2, Ring & Cone Grinders
2—13-in. Symons Disc

FURNACES

3—10x16-in. Muffle, Gasoline Fired, 12—20-gram Crucibles
1—10x16-in. Muffle, Oil Fired
4—12x20-in. Muffle, Oil Fired, 18—20-gram Crucibles
2—17x23-in. Muffle, Oil Fired, 30—20-gram Crucibles
4—No. 13 Wilfley Laboratory Concentrating Tables
3—2,000-gram, Denver "Sub-A" Laboratory Flotation Machines
2—500-gram 'Sub-A" Laboratory Flotation Machines
3—18x6-in. Conical Laboratory Ball Mills
2—No. 6 Wilfley Half Size Test Concentrating Tables
2—No. 60, Oil Fired Crucible Melting Furnaces
4—24-in. Diam. Arrastra Type Amalgam Clean-Up Pans



ELECTRIC VIBRATING SCREENS

4—Type 42, Hum-mer, 4-ft.x5-ft. Enclosed
8—Type 39, Hum-mer, 4-ft.x5-ft. Open. These screens can be furnished single or double deck, in Tandem or Duplex Units, with or without feeders.
6—G-2, and G-4, Hum-mer Motor Generator Sets for Above Screens.
4—Type 5, 40-in.x60-in. Mitchell Single Surface, 3-ph. 60-cy. 440-volt Electric Screens, with Starters.

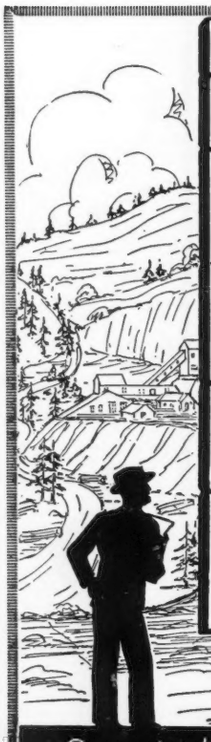
MECHANICAL VIBRATING SCREENS, BELT DRIVEN

4—36-in.x36-in. Colo. Iron Works Impact
6—36-in.x48-in. Colo. Iron Works Impact
1—6-ft. Sturtevant-Newago, Double Deck
2—8-ft. Sturtevant-Newago, Double Deck
3—3-ft.x5-ft. Tyler, Double Deck
4—6-ft.x5-ft. Tyler, Double Deck
4—4-ft.x6-ft. Niagara, Double Deck
2—Bunker Hill Screens

Send for Complete Stock List No. 23

MORSE BROS. MACHINERY COMPANY

2900 Broadway **Denver, Colo., U. S. A.** **P. O. Box 1708**



KNAPP
BARGAIN
BULLETIN BOARD

SPECIALS!
in HOISTS

25 HP Single Drum Electric
37 HP Single Drum Electric
50 HP Single Drum Electric
50 HP Double Drum Electric
50 HP Double Drum,
Steam or Air

Guaranteed Mining and Milling Equipment

J. E. KNAPP CO.

593 MARKET ST., SAN FRANCISCO, CALIF.

GOOD USED EQUIPMENT

12—**Oliver Filters:** 6x12, 6x8, 6x6, 6x4, 3x2.
4—**American Filters:** 48"—1; 6'—2; 6'—4 disc.
6—**Portland Filters:** 12'x12'.
8—**Dorrco Filters:** 10' dia. x 14'; 8x12, 8x8, 8x2, 6x8.
1—24"x36" **Allis-Chalmers Jaw Crusher;** selection of smaller & larger sizes.
3—4'x8' **Allis-Chalmers Vibrating Screens,** 2-deck.
1—3'x6' **Niagara Vibrating Screen,** 2-deck.
8—**Rotary Kilns:** 6'x40', 6x60, 7'6x100, 8x110, 8x125, 9'6x150.
4—**Ruggles Coles Class A Rotary Dryers:** 5'x26', 5x30, 6x45, 80"x40'.
7—**Direct Heat Rotary Dryers:** 4'x30', 5x30, 5x50, 6x40, 6x60, 8x60.
12—**Coal Pulverizers:** 4 Size A Erie City; Sizes A & D Aero; 4x8 Kennedy and #50, 55, 90 Raymond Imp Mills.
9—**Hardinge Ball Mills:** 4½'x16", 6x22, iron lined, and larger sizes.
1—#32 **Marcy Ball Mill.**
1—4'x8' **Kennedy Ball Mill,** iron lined.
5—Sets of **Crushing Rolls:** 42x16, 36x16", 30x10", 20x14".
Also all types and sizes of Jaw, Gyratory and Roll Crushers; Classifiers; Thickeners; Vibrating Screens; Separators; Pulverizers; Ball, Rod and Tube Mills; Rotary Kilns and Dryers; Filter Presses; Continuous Filters; Air Compressors; etc. Send for complete list.

CONSOLIDATED PRODUCTS CO., INC.
13-19 Park Row New York, N. Y.
Plant and Shops at Newark, N. J. Cover 8 acres of ground

There's just room enough here to remind you that this Section is the center for ads of "OPPORTUNITIES" in the metal mining field.

Can "Searchlight" Serve You?

AIR COMPRESSORS
360 ft. & 528 ft. Ingersoll-Rand Bltd.
354 ft. POV-2 Ingersoll-Rand Diesel.
3—752 ft. Sullivan 16x9¾x10-WJ 3.
1302—1503—2200—3600 ft., Elec. Drive.
MACHINERY
2—10B Bucyrus ⅜ yd. Elec. Shovels.
Jaw Crushers: 36x10, 36x6, 30x13, 7½x13, 24x36, 42x48, 60x84, 36x18, 11x16, 12x18 & 36x30.
Ball Mills: 3'x36", 7'x22", 8'x22" & 8'x10'.
Elec. Mine Hoists—30, 60, 110 H.P.
R. C. Stanhope, Inc., 875 6th Av., New York City

SHAFT ORE MINING EQUIPMENT

COMPLETE ELECTRIC
Must be moved soon
(Other Earth Handling Equipment, too)
IRON & STEEL PRODUCTS, Inc.
CHICAGO (Hegewisch Sta.) ILL.
"Anything containing IRON or STEEL"

New Searchlight Advertisements
Must be received by Dec. 31 to appear in the January issue.

Jaw Crushers—4"x8" up to 63"x84".
Crushing Rolls—10"x10" up to 54"x24".
Hereshoff 12' & 18' furnaces.
2—#7 **Kent Ring Roll Mills.**
Ring Roll Mills—No. 0 and No. 1—**Swing Hammer Mills—Gyratory Crusher.**
Rotary Fine Crushers No. 1, No. 1½, No. 0.
Direct Heat Rotary Dryers — 3½'x25', 4'x30', 5'x30', 5½'x40', 6'x50', 7'x50', 8½'x75'.
Semi-Indirect Heat Dryers—4'x30', 4½'x26', 5'x30', and 8½"x75'.
Cement Kilns—3' up to 9' diameter.
Marcy & Fuller-Lehigh Mills.
Raymond Mills—No. 00, No. 0 and No. 1 & 5-roll.
Tube—Rod-Compeb and Ball Mills 3' to 8' dia.
Dorr Classifiers & Thickeners.
1—6'x3'—6'x6'—6'x10'—12'x12' **Rotary Filters.**
3'—4½'—5' and 8' **Hardinge Mills.**
New Dryers built for all purposes.
1—20" **Allis-Chalmers** smelting furnace.

WM. P. HEINEKEN
95 Liberty St., N. Y. Tel.: Barclay 7-7298

FOR SALE

1—300 KW G.E. modern MG set, 250 volts DC 2300/3/60, 35% leading P.F. with swbds.
1—2500 HP AC Mill motor type MT, G.E. 2300/3/60/240 rpm with Mesta reduction gear. Excellent condition.
4—700 HP G.E. Sl. Rg. motors type MT, 2200/3/60/393 rpm.
4—500 HP, same as above at 450 rpm.
1—810 cu. ft. 100 lb. pressure Bury compressor belted to 139 HP G.E. syn. motor complete.
1—10 ton Milwaukee Gasoline Locomotive, 40" or 42" ga. Thoroughly reconditioned.
1—6 ton, same as the above.
1—150 KW G.E. MG set, 250 volts DC, 2200/3/60 AC syn. motor.
1—150 KW Westinghouse, same as above.

Large stock of DC variable speed motors and slip-ring motors carried in stock.

MOORHEAD-REITMEYER CO., INC.
Pittsburgh, Pa.

DIESEL ENGINES

80 HP. 4 cyl. Atlas Imperial
60 HP. 4 cyl. Fairbanks Morse
50 HP. 3 cyl. Worthington
50 HP. 4 cyl. International
15 HP. Stover Diesel

John Reiner & Co., Inc.
29 Howard St.
New York City

1
way to get
•
QUICK DELIVERY
•
VALUE RECEIVED
•
RESULTS!

UNUSUAL OPPORTUNITIES

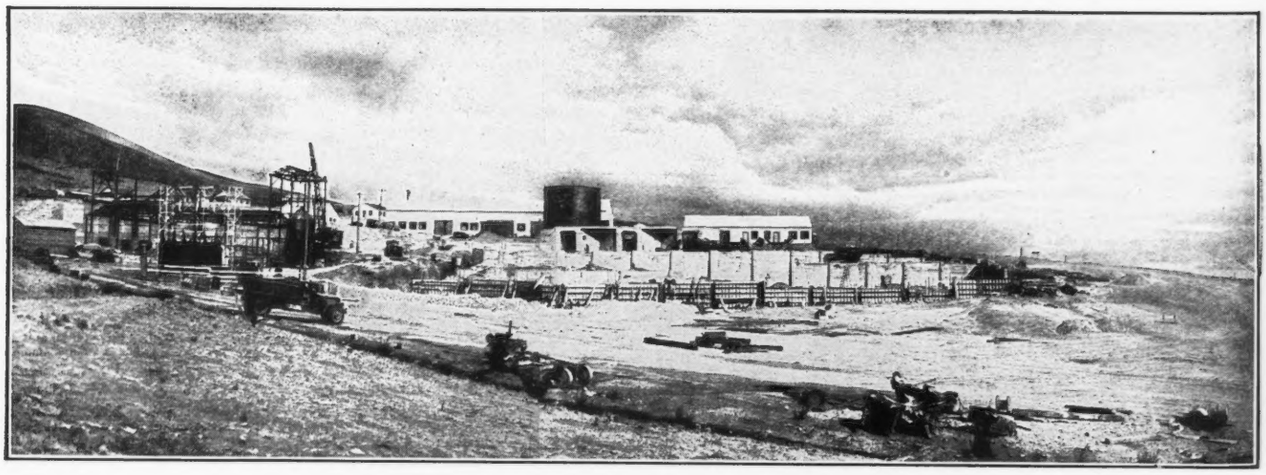
2—No. 54 **Marcy Ball Mills**
1—No. 64½ **Marcy Ball Mill**
1—6'x22" **Hardinge Conical Ball Mill**
3—Model D heavy duty **Dorr Classifiers,** size 6'x23'
1—54" **Akins Classifier** (new type)
3—Model C **Dorr Classifiers,** size 4'-6"x16'
2—Model C **Dorr simplex Classifiers,** size 2'-3"x14'-8"
1—4' **Symons Cone Crusher**
3—**Conway Mucking Machines** No. 60
2—5-ton **Atlas** 36" gauge combination battery & trolley **Locomotives**
1—75 H.P. **Joshua Hendy** single drum **mine hoist**
1—50 H.P. **Joshua Hendy** single drum **mine hoist**
4—20'x8' **Dorr Thickeners** complete
1—8"x10" single drum steam or air **mine hoist,** capacity 4500 pounds at 400 F.P.M.
5—30'x10' **Dorr Thickeners** complete
2—40'x10' **Door Thickeners** complete
1—60'x12' **Dorr Thickeners** complete
1—75'x12' **Dorr Thickeners** complete
2—16'x16' **Dorr Agitators**
2—30'x20' **Dorr Agitators**
1—**American disc filter,** 4' dia. x 3 discs
1—**American disc filter,** 6' dia. x 4 discs
1—**American disc filter,** 6' dia. x 2 discs
2—**Oliver Drum Filters,** 8'x12'
2—**Oliver Drum Filters,** 12x14'
1—**Oliver Drum Filter,** 14'x14'
1—400-ton solution capacity **Simultaneous Clarification-Precipitation Merrill-Crowe Plant**

"REBUILT BY EIMCO" . . . YOUR GUARANTEE

1
source for good used mining and milling equipment.
THE
EIMCO
CORPORATION
634 S. 4th West
Salt Lake City
Utah, U. S. A.

FOR BUSINESS "OPPORTUNITIES"—OFFERED OR WANTED
THINK "SEARCHLIGHT" FIRST!

Work "in progress" at Getchell Mine



25% COMPLETED OCT. 15, 1937
TO BE COMPLETED JAN. 15, 1938

600 Ton Cyanide and Roasting Plant

GOLCONDA, NEVADA

Complete design and erection by
WESTERN-KNAPP

WESTERN-KNAPP ENGINEERING CO.

Construction Engineers

COMPLETE MINE AND MILL INSTALLATIONS

593 MARKET ST., SAN FRANCISCO

500 North 16th Street, SACRAMENTO, CALIF.
1649 Blake St., DENVER, COLO.
1025 So. Central Ave., PHOENIX, ARIZ.
3649 Santa Fe Ave., LOS ANGELES, CALIF.
Cor. 3rd and So. W. 6th Streets, SALT LAKE CITY

NO JOB TOO TOUGH FOR OUR ORGANIZATION

MILL EQUIPMENT

GUARANTEED A-1 CONDITION

200 H.P. F-M Type "Y" Diesel-Generator
4½'x8' Roy & Titcomb Rod (or Ball) Mill
24' of Southwestern Matless Flotation Cells
2—28" Fagergren Float Cells
3'x4' Oliver Filter, complete
40 H.P. Drag Line Hoist
9"x14" Universal Crusher #3
2—4" Dorrco Diaphragm Pumps, misc. Sand and Solution Pumps Assay Office
Boarding House Equipment
Motors, ½ H.P. to 25 H.P.
Pipe, Fittings, Wire, Transformers, Lumber, Tools, etc.

MOLLIN MINING CO.
Mill Searchlight, Nevada
Head Office, 405 So. Hill Street, Los Angeles, Calif.

NEW AND USED
TUBING — CASING — PIPE

Large stocks carried everywhere

JOS. GREENSPON'S SON PIPE CORP.
Natl. Stock Yds. (St. Clair Co.), Ill.

WRECKING
GREAT LAKES EXPOSITION

Buy Nearly Twice As Much For Your Dollar

Miles of Versitol copper cable, Glyptol cable. Hundreds of panel boards and switches, 4 unit GE switch gear. Thousands of floodlights, safety switches, etc. Bring your electrical problems to us; our engineer will furnish free information to assist you. Write, wire, or phone Dept. 4.

Great Lakes Exposition Division
GLOBE WRECKING COMPANY
Lake Front Cleveland, Ohio

SPECIAL!
200 ALL-STEEL 50-TON BATTLESHIP HOPPER CARS

25—40 ton steel u/f flats.
20—50 ton steel u/f flats.
50—30 ton steel u/f flats.
200—30 ton steel u/f box cars.
75—30 ton steel u/f stock cars.
75—50 ton all-steel gons.

Narrow Gauge Dump Cars and Locomotives
Standard Gauge Dump Cars and Switch Engines

Locomotive Cranes

1—15-20 ton Link-Belt, 50 ft. boom.
1—20 ton Browning No. 8, 50 ft. boom.
1—30 ton Ohio. 50 ft. boom.
1—40 ton Brownhoist, 50 ft. boom.

Saddle Tank Locomotives

1—32 ton American, Std. Ga.
1—40 ton Baldwin, Std. Ga.
1—40 ton geared Heisler, Std. Ga.

RAILS

Complete Stocks Carried at Principal Points Throughout the Country

HYMAN-MICHAELS COMPANY
122 SO. MICHIGAN AVE. CHICAGO, ILL.
ST. LOUIS • NEW YORK • SAN FRANCISCO • SEATTLE

3—50 HP Clyde electric hoists
1—Connersville Blower
2—Buffalo blowers
3—I-Rand sinking pumps
3—I-Rand Pumps CRYH
3—I-Rand piston pumps, GSS
6—Sullivan DD scraper hoists
8—L9 Sullivan & I-Rand jackhammers
J. T. WALSH
Brisbane Bldg. Buffalo, N. Y.

EXCEPTIONAL OFFERINGS

6½ yard Bucyrus 320-B Electric Shovel.
3—1000 GPM—350' H Motor Driven Pumps.
2 yard Monighan Steam Dragline.
301 Koehring Gas. Cat. Crane, 1 yd. Buck.
Also Gas or Steam Locomotives and Dump Cars.
IRON AND STEEL PRODUCTS, INC.
CHICAGO (Hegewisch Sta.) ILL.
"Anything containing IRON or STEEL"

FOR SALE

(1) Slightly used portable **Air Compressors,** single stage or two stage types.
(2) Surface Combustion used **Gas Furnace** for tempering steel, complete with Blower and controlling pyrometer.
SALMON & COWIN, Inc.
930 Second Avenue North, Birmingham, Alabama

ROTARY FILTERS

2—Portland 12' x 12' Rotary Vacuum Filters, complete with Oliver 14"x8" Dry Vacuum Pumps and Receivers. In operation less than three months.

FS-783, Engineering and Mining Journal 330 West 42nd St., New York City

POSITIONS VACANT

A LONG ESTABLISHED Mining Company treating large tonnages in Middle West wishes to secure the services of a man having broad metal mining experience for the position of Efficiency Engineer. Also want experienced shift bosses. Only experienced technical men need apply. Give detailed experience and references in first letter. Opportunities for advancement good. P-781, Engineering and Mining Journal, 520 No. Michigan Ave., Chicago, Ill.

MILL DESIGNER, CONSTRUCTION Sup't foreign, high altitude, healthful location. Salary $350 U. S. currency per month. Traveling expenses from point of engagement and return on completion three years contract. Glenn B. Wilson Employment Specialists, 307 Continental Oil Bldg., Denver, Colo.

EMPLOYMENT SERVICE

SALARIED POSITIONS, $2,500 to $25,000. This thoroughly organized advertising service of 28 years' recognized standing and reputation carries on preliminary negotiations for position of the caliber indicated through a procedure individualized to each client's personal requirements. Several weeks are required to negotiate and each individual must finance the moderate cost of his own campaign. Retaining fee protected by a refund provision as stipulated in our agreement. Identity is covered and, if employed, present position protected. If you have actually earned over $2,500, send only name and address for details. R. W. Bixby, Inc., 264 Delward Bldg., Buffalo, N. Y. (E. M. J.)

POSITIONS WANTED

MINING ENGINEER, 36, experienced examination lode, placer, geological surveys, mine operation construction work, tonnage control, estimates, four years' Latin-America fluent Spanish. PW-721, Engineering and Mining Journal, 330 West 42d Street, New York City.

STENOGRAPHER-ACCOUNTANT six years' thorough experience, copper, gold, silver mining-milling, age 45, best references. PW-793, Engineering and Mining Journal, 883 Mission Street, San Francisco, Calif.

AUCTION—See page 106

POSITIONS WANTED

WILL GO ANYWHERE: — Young, strong healthy civil engineer of 10 years' experience in designing constructing concrete roads and bridges. Has ambition and desires to enter the mining field in any capacity, any location. Willing worker, best of references. PW-762, Engineering and Mining Journal, 520 No. Michigan Ave., Chicago, Ill.

MANAGER OR SUPERINTENDENT. Engineer who has specialized in Gold Mining. Wide experience in every detail of operation. Mining, Milling, Mill construction, Flotation, Cyanidation, Hydro-Electric Power development. Now employed as Manager, seeks change. Speaks Spanish. PW-782, Engineering and Mining Journal, 520 No. Michigan Ave., Chicago, Ill.

AMERICAN GRADUATE ENGINEER with twenty-five years' experience in positions of responsibility with prominent corporations in industrial plant design, construction, and operation, including mining and quarrying in the U. S. and Latin America, now employed is seeking a connection presenting a better opportunity. PW-794, Engineering and Mining Journal, 330 West 42nd Street, New York City.

MINING ENGINEER, M.C.M.&T., 1937 graduate, wishes position as Junior Engineer. Mine surveying experience, single. Mark F. Graham, Harbor Springs, Michigan.

SPECIAL SERVICE

OIL, MINING, INDUSTRIAL, investigations and appraisals made, anywhere, under technical supervision of experienced, reliable personnel. Brookfield Exploration Co., Milam Bldg. San Antonio, Texas.

BUSINESS OPPORTUNITIES

For the information of Readers:
Organizing and incorporating costs incurred in connection with capital raising are usually quoted as a separate cost not conditioned upon or related to the actual raising of capital or any fees earned thereby

Raising Capital

Inquiries solicited from corporations interested in raising capital through marketing of corporate securities. The Brookworth Co., Inc., 110 East 42nd St., New York.

Gold Placer

LARGE RICH GOLD Placer cash 3% of lowest official engineers' reports. H. C. Sprinkle, Canon City, Colorado.

BUSINESS OPPORTUNITIES

Capital Needed

WANTED: Three thousand five hundred dollars ($3,500) to make drive for known high grade gold ore, Cripple Creek District, Colorado. Darwin T. Mason, (temporary) address, 2215 East Third St., Tucson, Arizona.

Gold Mine

Developed Property, ready for expansion, gold predominant, owner's estimates 1,600,000 ore reserves. $550,000 shipping record. E. A. DeBrail, Box 313, Florence, Ariz.

FREE BULLETIN

USED EQUIPMENT bulletin No. 38—8 pages, 3½x8½; classified. Write to Jno. D. Fidler, Mid-Continental Equipment Co., 710 Eastgate, St. Louis, Mo.

FOR SALE

Five patented gold and silver mining claims, approximately 75 acres virgin ground and three well-defined fissure veins, near Kingman, Arizona.

FRED S. CALDWELL
408 Midland Savings Bldg.,
444 Seventeenth St., Denver, Colorado

THE TONOPAH MINING CO. OF NEVADA

EXPLORATION DEPARTMENT
Prospects of Merit Financed
Write Either

H. A. JOHNSON
Supt. of Operations
Tonopah, Nevada

Or Main Office
570 Bullitt Bldg.
Philadelphia, Pa.

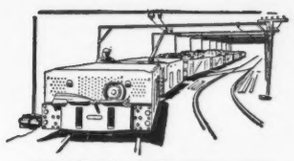
DIVIDEND NOTICE

ANACONDA COPPER MINING CO.
25 Broadway
New York, November 24, 1937
DIVIDEND NO. 120

The Board of Directors of the Anaconda Copper Mining Company has declared a dividend of Fifty Cents (50c) per share, upon its Capital Stock of the par value of $50. per share, payable December 20, 1937, to holders of such shares of record at the close of business at 3 o'clock P.M., on December 3, 1937. D. B. HENNESSY, Secretary

"Where's all your stock of lubes?"

"*That's all we need since they made that* LUBRICATION SURVEY!"



SUPERLA GREASES CUT HAULAGE EXPENSE

Anti-friction bearing wheels in mine cars bring a definite reduction in haulage power costs. But unless the right lubrication is supplied, increased maintenance can offset the power saving advantage.

Superla Greases — in seven grades — will solve this problem. They provide the correct grade for every type of anti-friction wheel bearing for summer or winter operation.

Materials used in the manufacture of Superla Grease are the best obtainable. Higher viscosity oils provide a tougher lubricating film. They contain no filler, grit or corrosive substance and no perfume or artificial odor. Manufactured under laboratory control, they provide thoroughly uniform consistencies that you can rely on to further reduce power consumption, maintenance and lubrication in your haulage costs.

A Standard Oil representative will be glad to specify the correct grade of Superla Grease for your particular conditions.

Copr. 1937, Standard Oil Co.

A THOROUGH, scientific examination of your lubrication requirements by a Standard Lubrication Engineer will show *many* ways in which you can save money, particularly on your stock of lubricants.

Complicated lubricant stocks are hard to handle and dispense, and confusing to stock clerks and oilers alike. As a result of this confusion, lubrication recommendations are frequently ignored, definitely contributing to higher maintenance and lubricating costs.

A lubrication survey in your plant may show many instances in which one lubricant can replace three or four brands now carried. The saving this means is evident: reduced stock, less waste, less handling and lubricating time, and above all, full assurance of the right lubricant for every job.

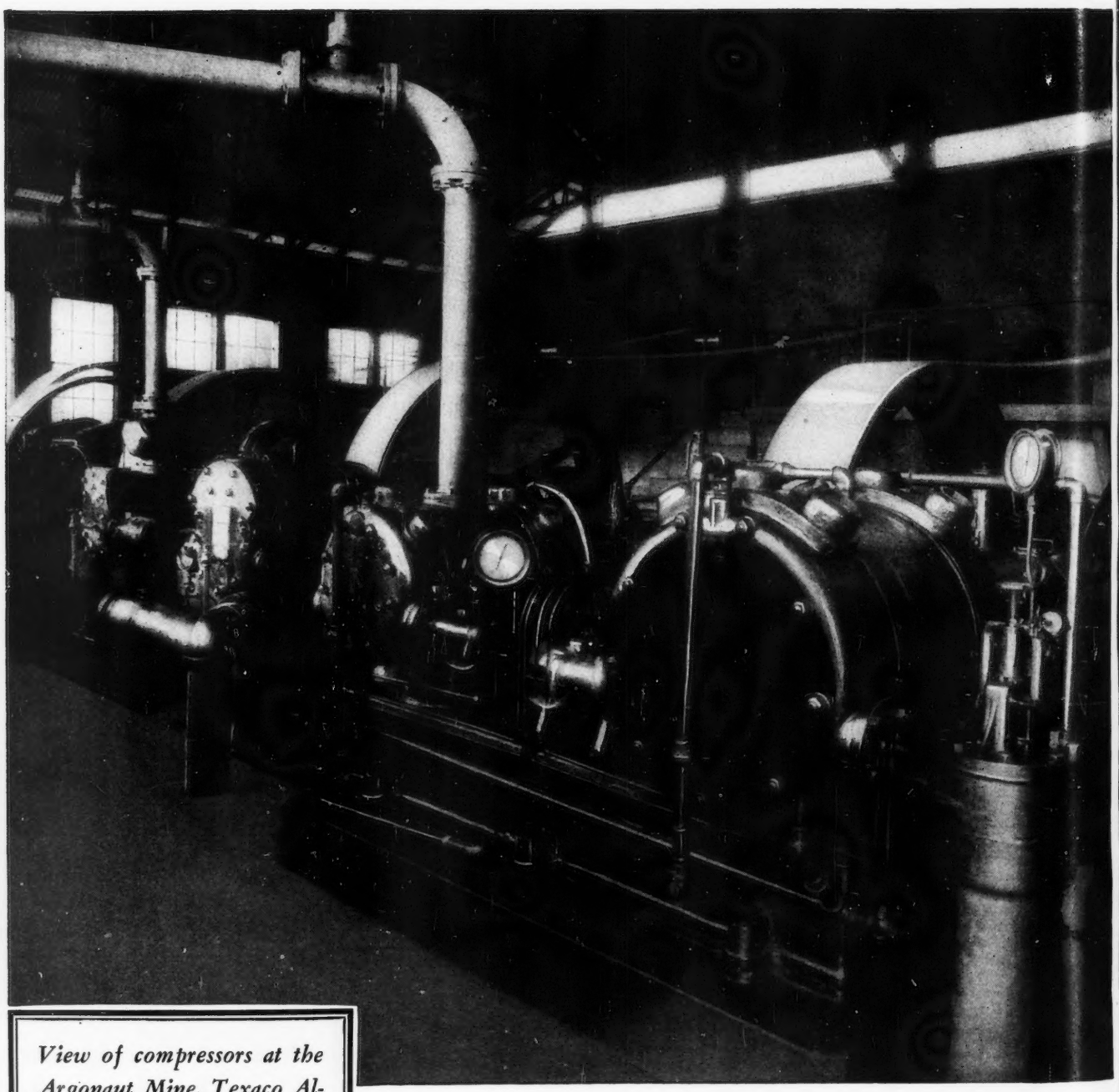
Call the Lubrication Engineer at your local Standard Oil (Indiana) office. Let him tell you *how* a lubrication survey can bring about further cost reduction in your own plant. There's no obligation. Make an appointment with him today.

THE RIGHT LUBRICANT • PROPERLY APPLIED • TO REDUCE COSTS

STANDARD OIL COMPANY (INDIANA)

LUBRICATION ENGINEERING

In the famous



View of compressors at the Argonaut Mine. Texaco Alcaid keeps rings free, valves properly seating, the whole compressor clean.

TEXACO

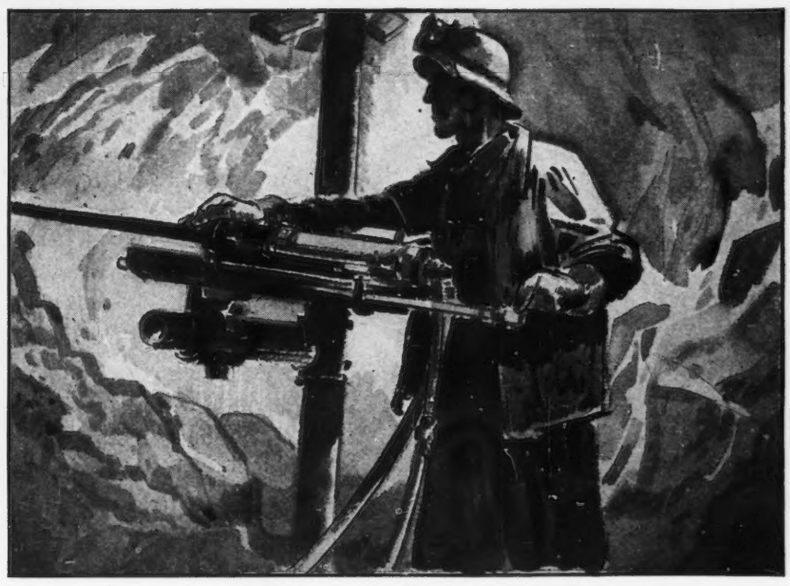
MOTHER LODE...

"THE ARGONAUT MINE at Jackson, Amador County, is situated in the heart of the famous Mother Lode of California. This gold mine is mining ore from the 6,000 foot level where some of the working faces are approximately 1½ miles from the compressors. The compressors supplying the compressed air are lubricated with Texaco Alcaid Compressor Oil." The above is from a letter written by Alex F. Ross, Superintendent.

From experience, Mr. Ross knows that Texaco Compressor Oils can be counted upon to give him long, continuous service. He knows that they keep his compressors *clean,* free from gumming and consequent ring sticking with which he formerly was faced.

Trained lubrication engineers are available for consultation on the selection and application of Texaco Compressor and Air Tool Lubricants. Prompt deliveries assured through 2070 warehouse plants throughout the United States.

The Texas Company, 135 East 42nd Street, New York City.



AIR TOOLS—You can be sure of a big day's work . . . every day...for each drill, when it's on Texaco. And this is all anyone can expect of his drills. Above all, don't attempt to save money on air tool lubricants . . . you'll end by having to spend several times more on repairs than your "savings."

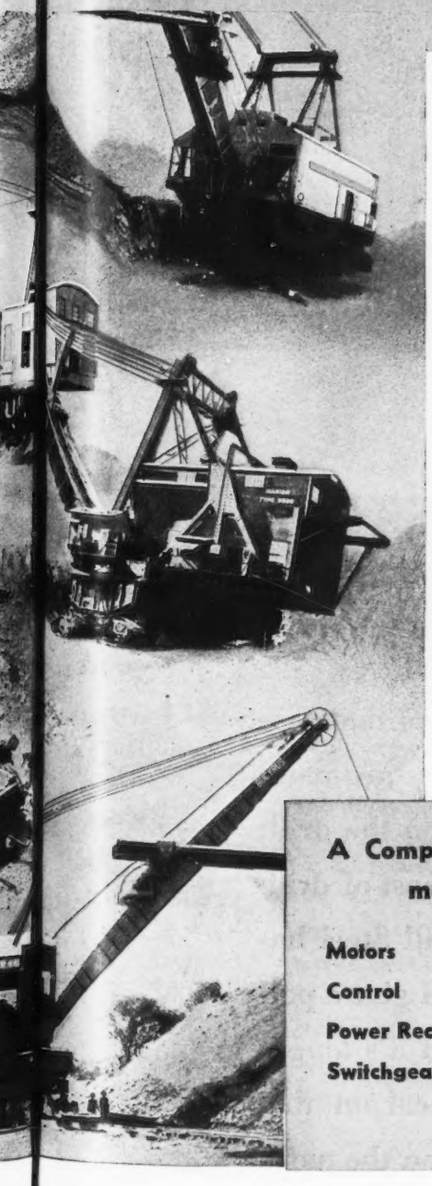
TEXACO
REG. T. M.

COMPRESSOR AND AIR TOOL *LUBRICANTS*

Why G-E EQUIPPED THROUGHOUT THE OPEN-

G E N E R A L

SHOVELS ARE USED PIT MINING FIELDS



THERE is good reason for the fact that wherever open-pit mining operations are being carried on, you are practically certain to find G-E equipped shovels in service.

PIONEERS IN DESIGN

G-E engineers pioneered in designing and applying electric equipment for power shovels. They have maintained their leadership with such developments as the application to shovels of d-c apparatus, the use of the generator-field control principle with variable-voltage features, and the introduction of separately excited motors.

OUTSTANDING PERFORMANCE

Furthermore, performance records of long life, low maintenance, and efficient operation have won for these shovels the complete confidence of the mining industry.

G-E equipment makes possible fast yet amazingly smooth acceleration, high operating speeds with full load on the motors, and, in contrast, near-zero speeds and stalling to prevent damage to electric or mechanical equipment.

With this equipment, control maintenance expense is cut to practically nothing; and because such smooth and flexible operation is obtained, wear and tear on the shovel itself is greatly reduced.

G-E equipped shovels can help you to lower the cost per ton of coal or ore produced. Make sure, therefore, to specify G-E equipment on your next shovel. General Electric Company, Schenectady, New York.

A Complete Line of Electric Equipment for Mining Service

Motors	Substation Apparatus
Control	Cable
Power Rectifiers	Lighting Equipment
Switchgear	Mining Locomotives

Transformers

011-211

E L E C T R I C

THE ROUGHER AND TOUGHER THE DRILLING

. . . the more perfect you need the drill

MIDVALE DRILL STEEL

thrives on tough jobs

Water holes that clog up, tips that lose their edge or break off—these are more than a nuisance to the man on the drill; they're a real addition to the cost of drilling. Midvale Smooth 'Ole Drill Steel has a perfect hole for water—will give a perfect edge for "cutting"—and it's *tough*. You'll find it most economical on that work which normally costs you the most.

THE MIDVALE COMPANY • NICETOWN • PHILADELPHIA

OFFICES: *New York • Chicago • Pittsburgh • Washington Cleveland • San Francisco*

Speed! Speed! Speed!

CRIES INDUSTRY

Today's severe demands on equipment call for utmost wire rope stamina

Industry must reduce costs—to make profits. More work from existing equipment—and faster.

Roebling "Blue Center" Steel Wire Rope has more than met these exceptionally severe requirements.

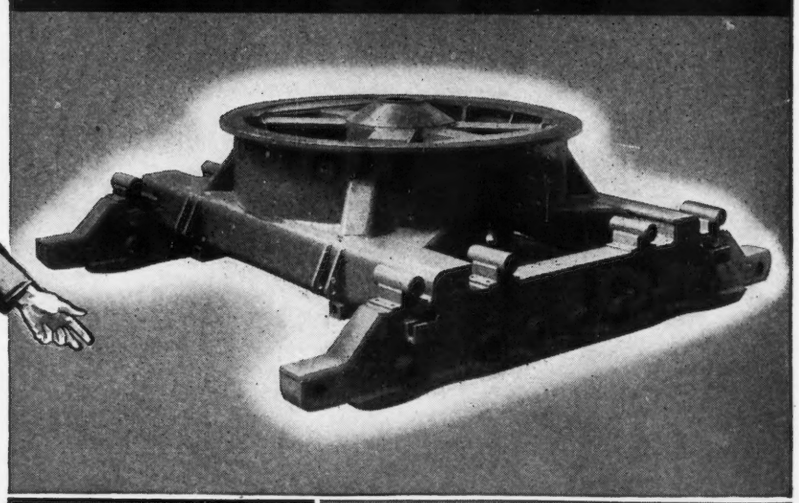
Roebling "Blue Center" combines the highest strength with the maximum resistance against fatigue and wear. For a wide variety of applications where service conditions are exceptionally severe, *it has proved conclusively that it assures lowest general average operating costs.*

JOHN A. ROEBLING'S SONS CO., TRENTON, N.J. *Branches in Principal Cities*

The Highest Development in Roebling Wire Rope
1 STRONGER
Wire of highest strength consistent with ductility and toughness
2 TOUGHER
Provides maximum resistance against wear, sudden shocks, vibration
3 SAFER
Unequalled for uniformity of quality
4 SAVING
Insures lowest general average operating cost

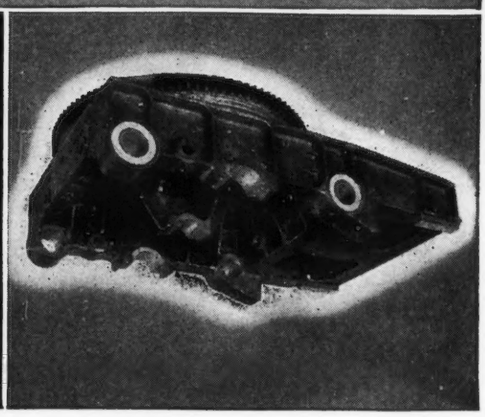
ROEBLING ✦ BLUE CENTER

Look AT THIS NEW AND BETTER DESIGN



ABOVE: Modern P & H carbody, a rigid, welded unit of tough alloy steels.

RIGHT: Old type carbody; made of clumsy castings bolted together—



P&H Pacemakers-FASTER ON THE JOB

● Here, in a nutshell, is the story of all-welded excavator construction with alloy steels. At the bottom is an old type carbody . . . it is cast . . . subject to cracking under strain . . . its actual strength is never known. . . . Above is the new type P&H carbody, made of tough rolled steels. Every inch of its uniform cross-sectional strength is accurately predetermined. The welds are actually stronger than the parent metal itself. This new carbody eliminates a good 25% dead weight, reduces ground pressure, costs less to run, less to maintain. The excavator industry will gradually adopt this more practical design. For information on P&H excavators from 3/8 to 5 cu. yds. capacity, address the Harnischfeger Corp., 4454 W. National Ave., Milwaukee, Wis.

HARNISCHFEGER
CORPORATION

EXCAVATORS ★ ELECTRIC CRANES ★ ARC WELDERS P&H HOISTS ★ WELDING ELECTRODES ★ MOTORS

SELDOM LAID-UP *for* REPAIRS

...because they're constructed of

ALLOY NICKEL STEELS

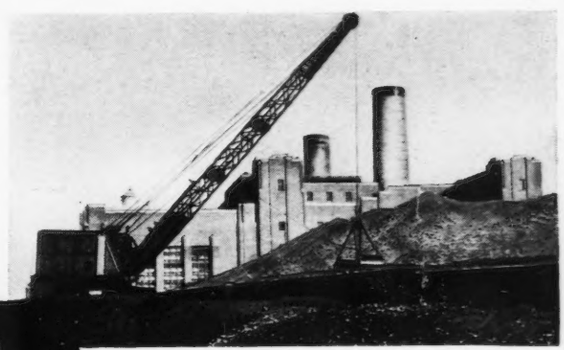
Courtesy of Marion Steam Shovel Co., Marion, Ohio.

No class of machinery tackles tougher assignments than excavating and material handling equipment such as conveyors, power shovels, cranes and drag lines.

Whether they are used for road building, foundation excavating, dam construction, surface mining or the scores of other construction jobs, they encounter high static and dynamic stresses, also heavy wear and abrasion.

Once the master mechanic and his crews worked many an hour of overtime to keep these machines in repair. But not so to-day.

Through the use of tough, strong, hard, wear-resisting Nickel Alloy Steels, leading manufacturers are turning out machines that perform dependably day in and day out with few interruptions due to breakage or excessive wear of vital parts.



Courtesy of Link-Belt Co., Chicago, Ill.

Courtesy of the Wellman Engineering Co., Cleveland, Ohio.

APPLICATIONS
of the Nickel Alloy Steels in excavating and material handling equipment

- Racks, booms, sheaves
- Upper and lower frames
- Rollers, Large gears
- Pinions and sprockets
- Crawler parts
- Hoist and drive gears
- Hoist drum shafts
- Shipper shafts
- Track pins
- Dipper buckets
- Bucket teeth and lips

Listed at the left are some of the applications where forged and cast Nickel Alloy Steels are generally used to-day to make this type of equipment more reliable.

Consultation is invited on the use of enduring Nickel Alloy Steels in your equipment.

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N. Y.

Wire rope and strand

Bethlehem makes a type of wire rope for every kind of mining equipment. When special conditions are encountered, the broad experience of Bethlehem wire-rope engineers and metallurgists paves the way for quick solution of the problem.

BETHLEHEM STEEL

BETHLEHEM

Bethlehem's line of steels for mining

The recent acquisition of the Williamsport Wire Rope Company places Bethlehem in a position to supply your requirements for wire rope and strand as well as the other steel products used in mining.

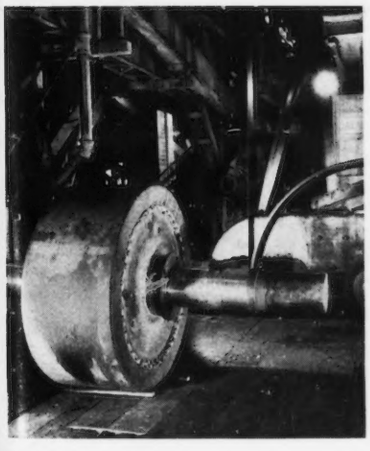
In Bethlehem Wire Rope you will find all of the thoroughgoing dependability that has been associated with the name Williamsport for nearly fifty years. And it is only natural to expect that these quality standards will be enhanced by the metallurgical and manufacturing experience of an organization making virtually all kinds and forms of steel for all industries.

The inclusion of wire rope in the list of Bethlehem steel products makes it possible for mine operators to obtain practically every form of steel they need from this one source. Bethlehem Steel Company has long been in close contact with the steel requirements of the mining industry through the supplying of ties, rails, drill steel and a wide range of other items.

Now, with the engineering personnel of Williamsport Wire Rope Company part of the Bethlehem organization, this company is in a position to render an even broader service in connection with the supplying of the various materials that take the brunt of mining.

With Bethlehem warehouses from coast to coast stocking wire rope and strand, your needs can be supplied quickly.

OTHER BETHLEHEM PRODUCTS FOR MINING



Tough—all the way through

Crusher rolls and cone crushers must be made of husky material if they're going to operate efficiently and economically. 88–80 is a grade of steel especially developed by Bethlehem to have maximum resistance to all abrasive materials. This characteristic extends uniformly throughout 88–80 castings. The center is as hard and tough as the surface. They offer the same stubborn resistance to wear all the way through and all the way across the face. And there are no too-hard corners to break off.

Fast building with steel

If you want any type of steel structure to go up in the minimum of time, Bethlehem is in a unique position to handle the job. As the largest steel construction company in the world, Bethlehem has twelve conveniently located fabricating shops. In addition, complete depots of erection equipment are maintained at strategic points throughout the country. A further factor making for speed is this company's production of virtually every form of steel called for by modern structural practice.

Drill steel that can take it

We know what Superior Hollow Drill Steel will do before you get it. Before any Bethlehem Superior Hollow Drill Steel is released for shipment, representative bars from each melt must successfully pass block and simulated service tests that duplicate the severest operating conditions. You can count on Bethlehem Superior to turn in outstanding service records —to place stoping on new high levels of speed and economy. Bethlehem Superior has proved its stamina in every major field.

Other Bethlehem Products for the Mining Industry Abrasive-resisting plates; steel sheets; carbon-steel bars; steel mine ties; tool steels; bolts and nuts; steel pipe; Silvery Mayari Alloy Iron for longer-wearing iron castings.

STEEL COMPANY

EASY HOOKUP

Connect Up with

PROFITS Cordeau-Bickford, the insensitive detonating fuse, acts as the detonator in the hole and the hookup for *all* holes. It assures maximum power from every cartridge and more effective results from every shot. Larger blasts are made feasible, better fragmentation is secured, and much less time is lost in moving equipment back and forth. Time saved on loading the holes and on other operations means extra profits for you.

Write for a copy of the Cordeau Book, available without charge.

MAKERS OF ENSIGN-BICKFORD SAFETY FUSE SINCE 1836

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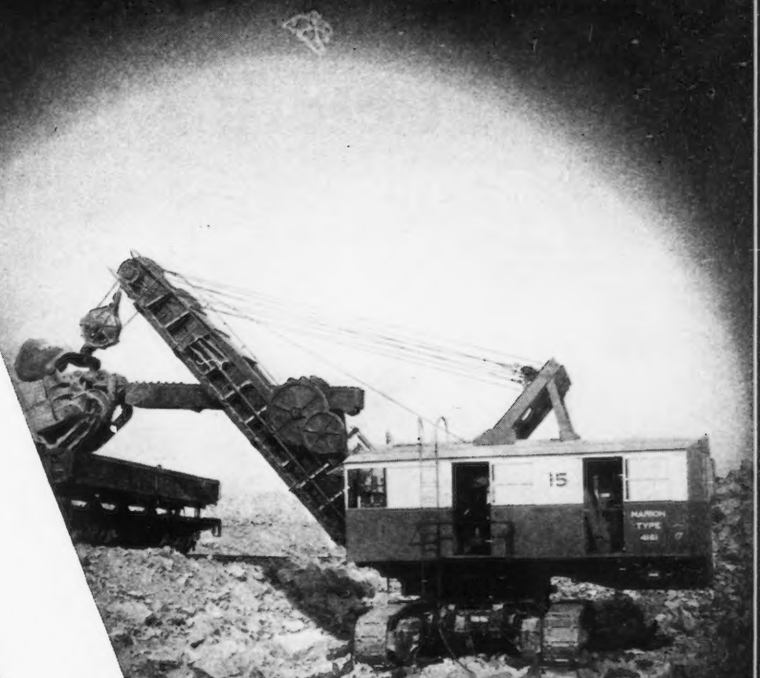
CORDEAU BICKFORD Detonating Fuse

THE ENSIGN-BICKFORD COMPANY

Simsbury, Conn.

IMPRESSIONS THAT BUILD *Confidence*



Each time a Marion moves forward, it means, the very thing for which it was designed has been accomplished . . . . maximum yardage at the lowest unit operating cost. It means sturdy construction has been combined with such desirable features as enclosed non-clogging crawlers, manganese steel shoes . . . "live" roller circle for even load distribution . . . simplified yet positive control, including steering from operator's station . . . plenty of reserve power . . . and proven performance. Buy with confidence . . . Buy a Marion. » » »

MARION'S INTERMEDIATE-SIZE EXCAVATORS

4101

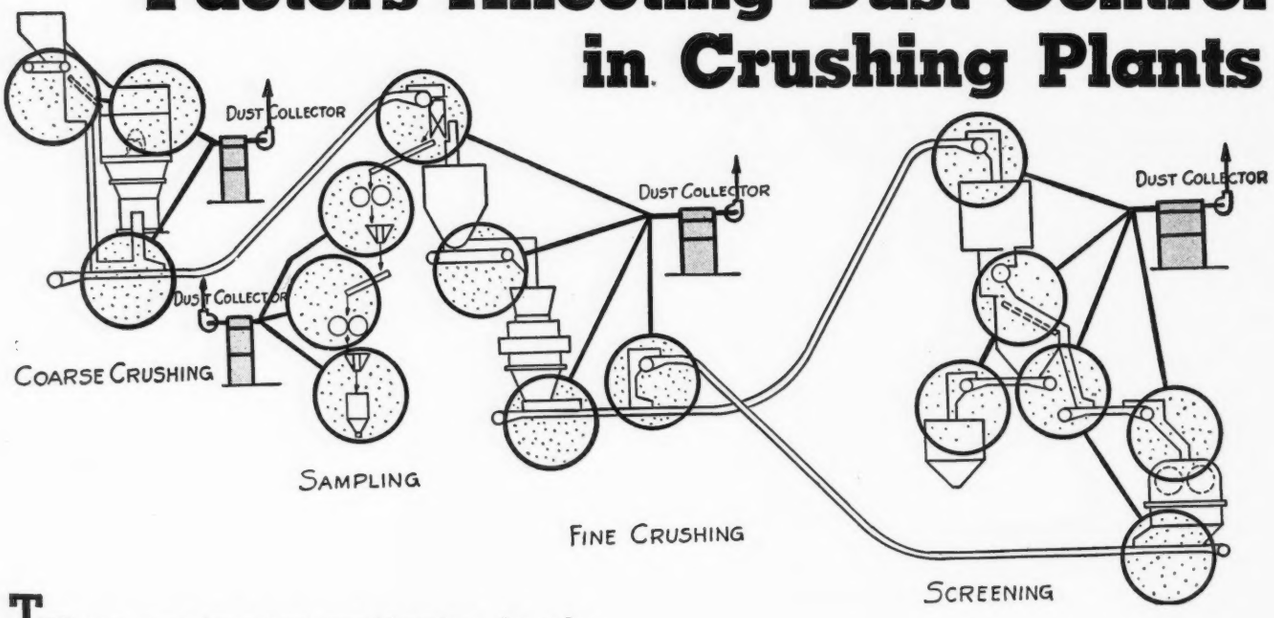
4121 **4161**

There is a Marion of the right size and capacity to master every material handling job. Write for bulletin.

The MARION

STEAM SHOVEL COMPANY • MARION, OHIO

Factors Affecting Dust Control in Crushing Plants



THE two most important considerations for adequate dust control in a crushing plant are the removal of the dust from the point of origin and its final collection for recovery of values. The size and types—or combinations of types—of equipment required for the purpose should be determined by careful investigation of the quantity and characteristics of the dust produced at any given point. Dust particles should be examined as to their silica content, size, shape, density, acidity, alkalinity, abrasiveness, temperature and wetness or dryness. After these determinations have been made and the operating conditions are known, the necessary equipment for most efficient dust control can be intelligently designed.

SPECIALIZED EXPERIENCE

Western Precipitation Corporation offers the full range of its experience obtained in thirty-one years of exclusive specialization on problems of dust, fog, fume and mist control. Removal of dust from the point of origin is effected by ingenious hood design, providing for adequate control without interference with operations. Equipment for final collection is designed in line with the findings of a comprehensive investigation. There may be a mechanical collector for either wet or dry operation. In some cases the dust may be recovered in the form of slurry that can be pumped directly to the mill. Depending on conditions, Multiclones, Polyclones or Cottrell Electrical Precipitators may be indicated. Special adaptations of such equipment can be made to solve **any** dust collection problem.

SERVICES AVAILABLE

Western Precipitation Corporation offers an engineering background that has been built up in a long period of international surveys of every problem of dust and fume control, and also the resources of a complete laboratory in which the most efficient systems and equipment have been pioneered. The solution of your problem at the lowest operating cost and to any desired efficiency is insured by this specialized experience.

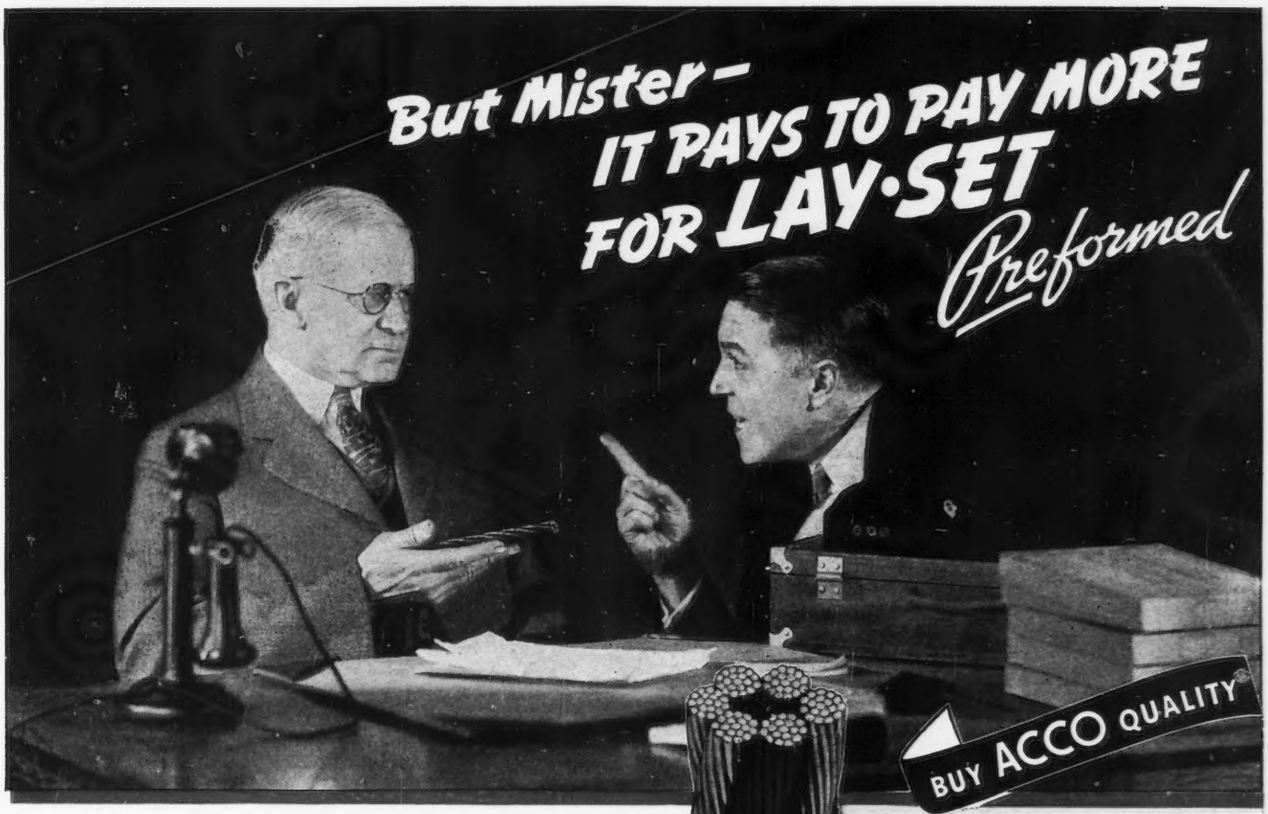
Send for Booklet

WESTERN PRECIPITATION CORPORATION

1012 West Ninth Street, Los Angeles, California • • New York, N. Y.

PRECIPITATION COMPANY OF CANADA, LTD., Montreal

PIONEER IN DUST AND FUME CONTROL



● "Sure it costs a little more—but listen: the increased service you will get out of LAY-SET Preformed will more than justify the slight differential in first cost. For instance:

"Your men can reeve LAY-SET in place and get your machine back into profitable production in about half the time they would spend on non-preformed. Then, with LAY-SET, your machine will have much longer continuous operation—because LAY-SET will last longer.

"If LAY-SET Preformed wears out to the point where the crown wires part—they won't wicker out to jab workmen's hands. It's a safe rope to handle. It resists kinking; almost refuses to whip and spools on the drum perfectly. Being preformed it resists the fatigue of reverse bending. Believe me, sir (and we've been in business for 91 years) LAY-SET Preformed is a much better rope."

HAZARD WIRE ROPE DIVISION
ESTABLISHED 1846
AMERICAN CHAIN & CABLE COMPANY, Inc.
WILKES-BARRE, PENNSYLVANIA
District Offices: New York, Chicago, Philadelphia, Pittsburgh, Fort Worth, San Francisco, Denver, Los Angeles, Birmingham, Tacoma

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Chain Hoists • Trolleys

HAZARD WIRE ROPE DIVISION
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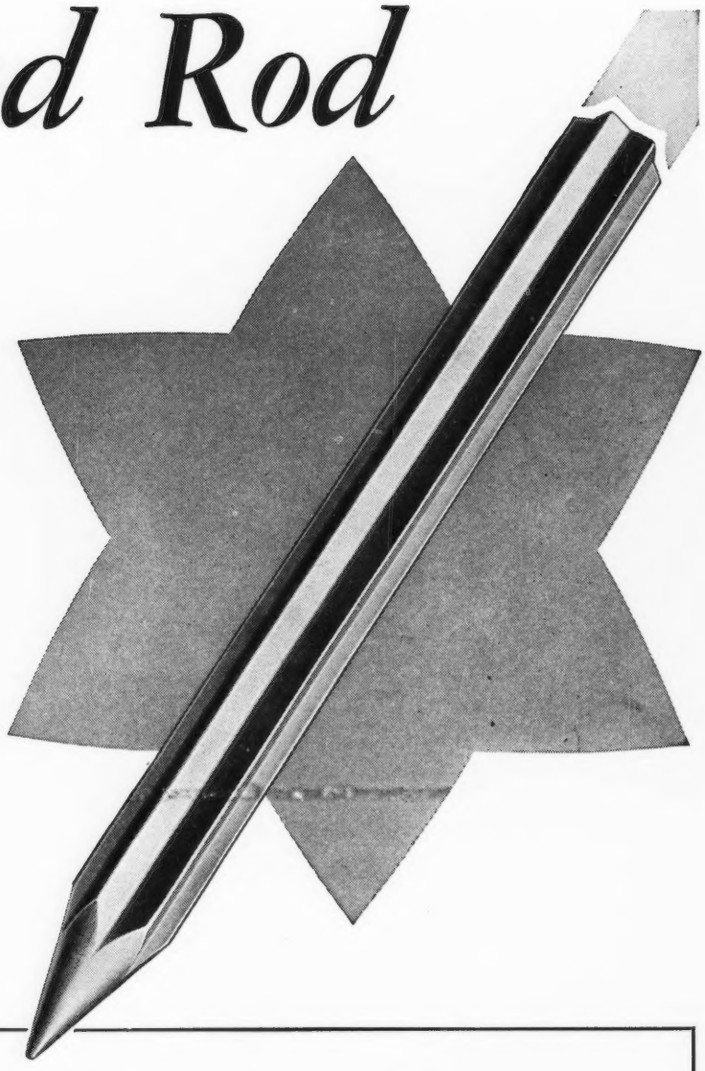
LAY·SET *Preformed* WIRE ROPE

✲ ALL HAZARD WIRE ROPES MADE OF IMPROVED PLOW STEEL ARE IDENTIFIED BY THE GREEN STRAND

A Ground Rod

of outstanding superiority...



Shaped like a star in cross-section and made of solid, hard-drawn, high conductivity Copper, the Anaconda Star Ground Rod* possesses all the properties essential for this type of service. Of especial interest are those outlined below.

*Patent applied for

ANACONDA
from mine to consumer
REG. U.S. PAT. OFF.

1. It is non-ferrous, non-corrosive, homogeneous throughout.
2. It offers full protection against galvanic or electrolytic action.
3. It assures intimate and permanent contact with the earth throughout its entire length, due to elimination of driving vibrations.
4. It provides a simplified method for connecting ground leads.
5. It offers extreme rigidity during driving, because of its star-shaped design, and is highly resistant to mechanical abuse.
6. It is adapted for temporary as well as permanent use and has the same high salvage value that characterizes all Copper products.

Anaconda Star Ground Rod... brand-new and better... is supplied in these standard sizes: nominal diameters of ⅝, ¾, and 1 inch; lengths of 6, 8, 10 and 12 feet... Additional technical data furnished on request.

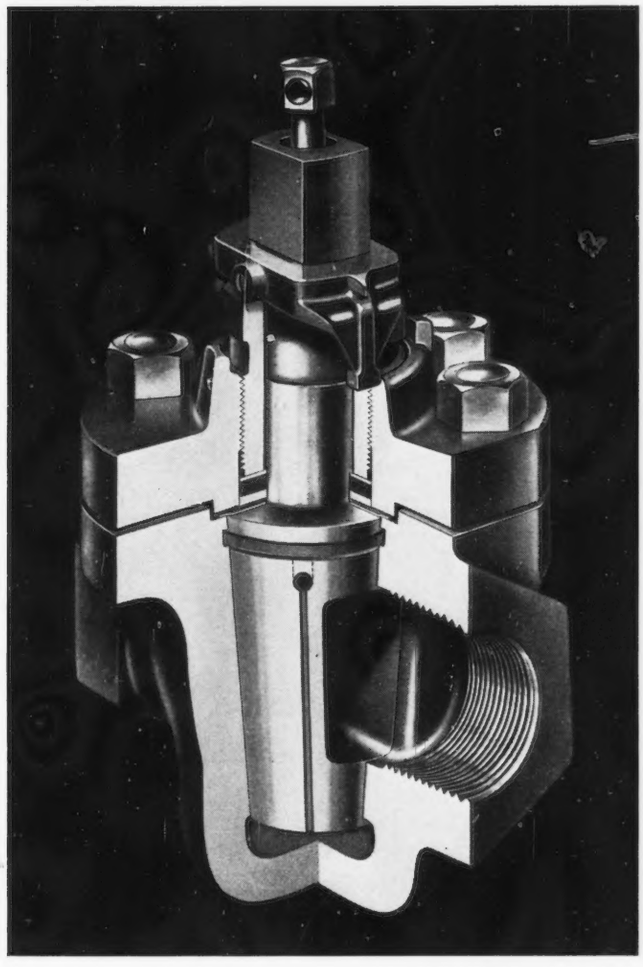
37640

Anaconda Wire & Cable Company

Gen'l Offices: 25 BROADWAY, NEW YORK • *Chicago Office:* 20 NO. WACKER DRIVE • *Sales Offices in Principal Cities*

These Valves WERE *Originally*

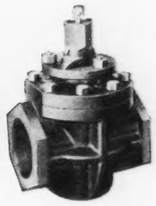
DEVELOPED FOR THE MINING INDUSTRY



Standard type, cross-sectional view.

Developed originally for the mining industry, today thousands of Nordstrom Valves are rendering satisfactory service in mines throughout the world. Their universal acceptance may be attributed to both engineering design and manufacturing methods. Ordinary methods of valve making are not tolerated in the manufacture of Nordstrom Valves. Nordstrom adds rigid tests to quality materials, expert fabrication and advanced principles of design. The combination has produced valves unequalled for economical, efficient service in all branches of the mining industry. Factory tests for Nordstrom Valves include a hydrostatic check for rupture that amounts to double the rated cold working pressure. Every valve must pass severe air tests for porosity and leakage. Every type of Nordstrom Valve embodies the patented hydraulic "Sealdport" lubricating principle. This provides an unbroken ring of special lubricant around both inlet and outlet ports, sealing off any possibility of leakage. Nordstrom Valves are leak resistant, easy turning, corrosion-resistant, quick operating, and compact.

Bell-end type.



4 Screw type.

Gear-operated.

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LUBRICATED PLUG VALVES

With Patented "Sealdport" Lubrication

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Address.....

City.....State.....

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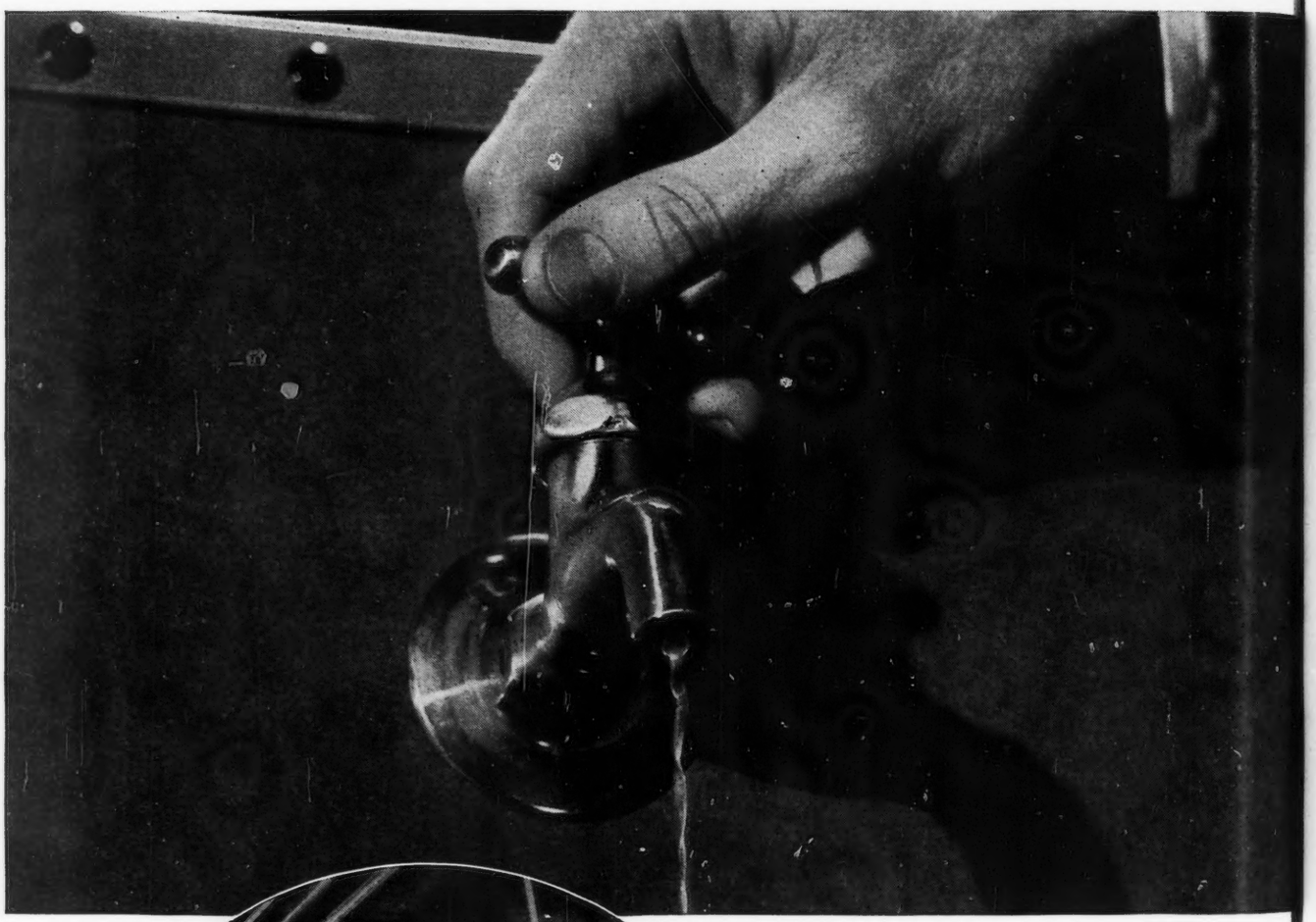


Bell & Zoller use miles of Anaconda cables

Miles of Anaconda trolley wire and feeder cables are furnishing safe and effective transmission of power to the extensive haulage and 100% mechanized mining operations of Bell & Zoller at Zeigler, Ill. This fine example of electrification is proof that modernized wiring pays in the coal industry. Anaconda offers modern, improved wire and cable that mean decidedly lower electrical costs, fewer breakdowns, more efficient machine operation. Let our engineers consult with yours and determine where savings can be made.

Anaconda

General Offices: 25 Broadway, New York

a dripping faucet

—why not stop invisible electrical leaks?

Neglecting electrical circuits costs mine owners thousands in breakdowns . . . high power bills

YOU can *see* a faucet dripping. But an overloaded electric circuit may be wasting money in the form of heat losses without your ever knowing it. Only the treasurer, wondering why bills are so high, suspects that something must be wrong.

Heat losses are but one way in which dollars fly out the window needlessly when electrical circuits are neglected. Frequent breakdowns are another. Men and machines stand around idle. Or, voltage drops reduce machine output. Lumped together, the damages the industrial plant suffers from antiquated, deficient wiring are often enormous. And authorities estimate that *nine out of ten industrial plants today are being penalized because of obsolete electric wiring!*

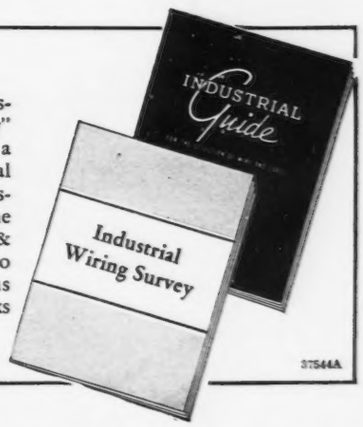
Safeguard your project

A wiring survey will cost you nothing and may save you thousands of dollars. We offer here a complete plan for such a survey. The books shown at right give you everything you need to initiate a check-up of your electric circuits. New, informative, they are being used by hundreds of concerns. Send for them today.

If you have a specific problem in mind, consult our Engineering Department. We will cooperate without obligation. Why not take advantage of the many important improvements in cable design pioneered by Anaconda Wire & Cable Co.? Let us tell you about them.

One of many Anaconda cables that save money in coal mine service

Security-Flex is an exclusive Anaconda design. The 60% all-rubber cord with the slip-proof plastic center and herringbone construction mean ability to "take it" in rough usage. On recommended list of U. S. Bureau of Mines. Write for further information on Security-Flex.



FREE! The "Industrial Wiring Survey" tells how to make a check-up of electrical circuits. The "Industrial Guide for the Selection of Wire & Cable" tells how to correct conditions found. Both books will be sent free.

37544A

Wire & Cable Company

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. . new F-M Simplex Pump

Simply by lifting it off or on wheels and axles, the new Fairbanks-Morse Simplex pump is made stationary or portable according to the immediate need.

The power end of the Simplex Pump is completely enclosed—oiltight for self-lubrication but quickly accessible through the bolted-on cover.

The fluid end is a single casting of exceptionally close grain, with large, direct openings permitting low velocity, minimizing wear. Rubber valves, generous use of stainless steel, and precision workmanship throughout guarantee year after year of trouble-free life. It is stripped to utmost simplicity by designers who know what a pump must do.

Supplied with belt drive or as a self-contained motor-driven unit offering undivided responsibility by an unquestioned leader in both motor and pump design.

Write for Bulletin 6155-27. Address Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. 34 branches at your service throughout the United States.

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AIR CONDITIONERS

Pumps

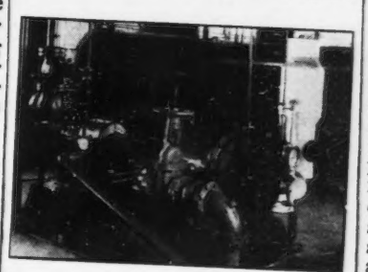
TELLTALE *Fingerprints*

● Unmistakably identifying the individual, fingerprints leave a record of their owner. Such records are being imprinted daily by busy fingers as they turn the pages of thousands of Crane catalogs.

In industrial plants everywhere—in purchasing departments—in engineering departments—in design, operation and maintenance of piping systems of all types, the Crane No. 52 Catalog is known as the dependable source book of buying, specifying and designing information.

Fingerprints on a Crane catalog identify not only the present leaders of American industry but that great army of workers of today who will be the big men of tomorrow. Turn to the pages of the Crane catalog whenever piping problems arise. Crane-Equip your plant for satisfaction.

FINGERPRINTS FOUND IN FAR PLACES



SAN FRANCISCO, CALIF., Nov. 18—If one could check all of the millions of fingerprints to be found in copies of the Crane No. 52 Catalogs, the most widely scattered of any industry would undoubtedly be those of men who mine the hard rock.

That is natural because in no other industry is unfaltering dependability and long life more needed than in the mines and mills far back from the main roads. Furthermore, Crane service through Crane distributors and Crane branches is so widespread that mining engineers find it easiest and quickest to get Crane valves and fittings.

The mountain of piping engineering data found in the Crane No. 52 Catalog is another reason why so many mining men find it handy to keep a No. 52 close at hand at all times. Look to your Crane No. 52 for information and equipment which will help you solve any piping problem to your lasting satisfaction.

CRANE

CRANE CO., GENERAL OFFICES: 836 S. MICHIGAN AVENUE, CHICAGO, ILLINOIS

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VALVES, FITTINGS, FABRICATED PIPE, PUMPS, PLUMBING AND HEATING MATERIAL

THE B & L DUST COUNTER WILL HELP YOU IN DUST CONTROL

Only through exact day to day knowledge of actual air conditions can this menace be defeated. This practical and efficient instrument permits an accurate check of dust concentration to be made at any time. Samples may be collected and examined on the spot or held for more leisurely examination in the laboratory.

It combines everything necessary for accurate checking of dust concentration. Consists of accurate air sampling device of the impinging type and a dark field microscope viewing and counting system, mounted on a circular base, provided with illuminating apparatus and suitably cased for safe transportation and storage.

Write for circular D-188 describing this instrument in detail. Address Bausch & Lomb Optical Co., 683 St. Paul St., Rochester, N. Y.

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CARD WHEELS

Semi-Steel Heat Treated

It's Tough Metal With A Deep Even Chill Positive "metallurgy control" gives Card Wheels that hardness where the wear comes — toughness where strength is needed. Made to any unpatented design —one wheel or a thousand.

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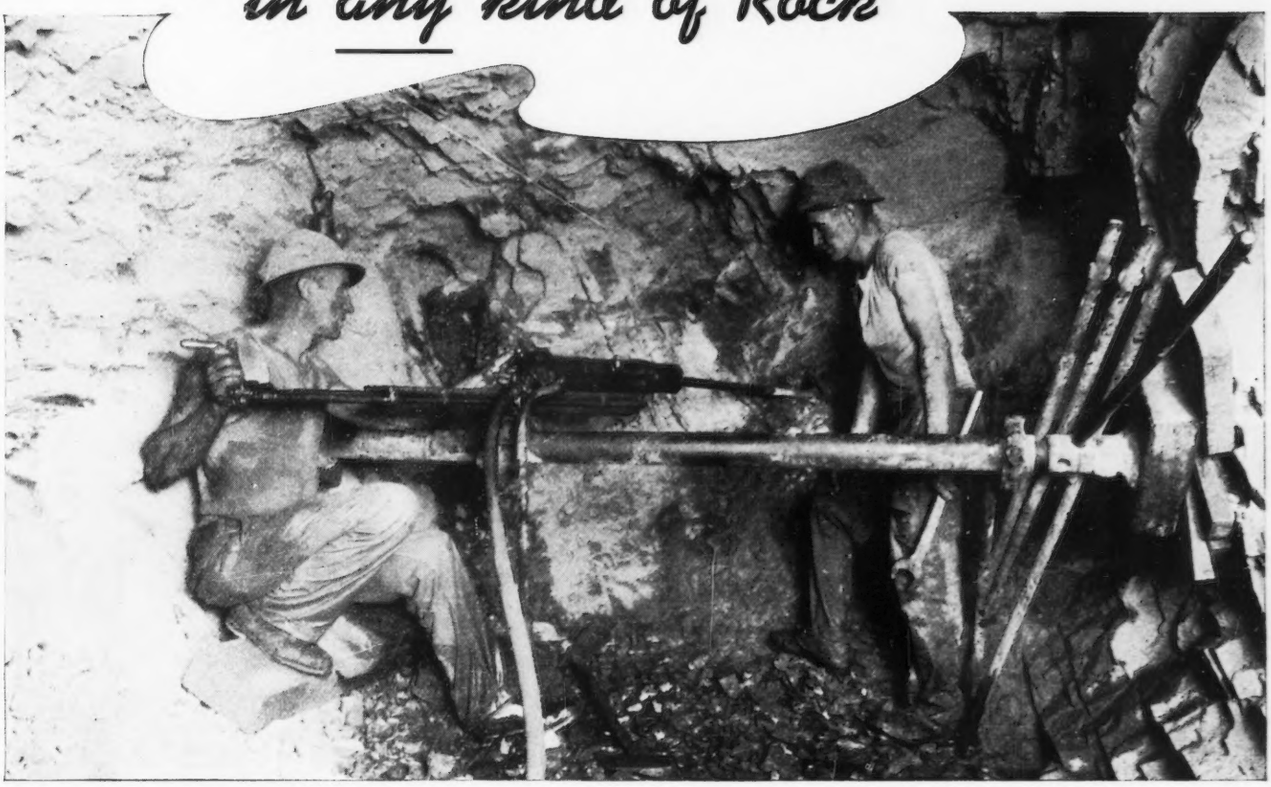

Drifting in diabase rock with TIMKEN Bits on the 3,200 foot level at the Magma Copper Company.

TIMKEN Rock Bits save drilling time and cut drilling costs in any kind of rock. Two main factors—both Timken developments—are responsible for the superior performance of TIMKEN Bits. They are (1) design; (2) material.

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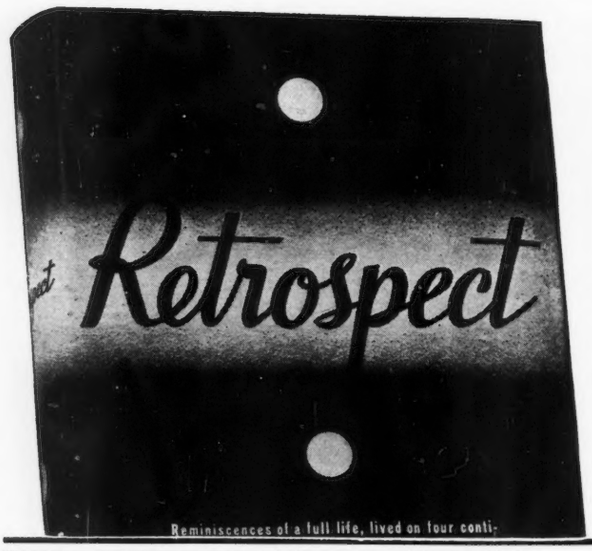

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Educated in Russia and England, T. A. Rickard began his mining career many years ago in Colorado. Subsequently his work took him to Australia, Alaska, Africa, Italy, Canada, England. Mining engineer; scientist; traveller; journalist; author; public speaker; citizen; these are some of the activities that have filled his exceptional career and have provided him with the substance of an exceptional book that you will enjoy reading.

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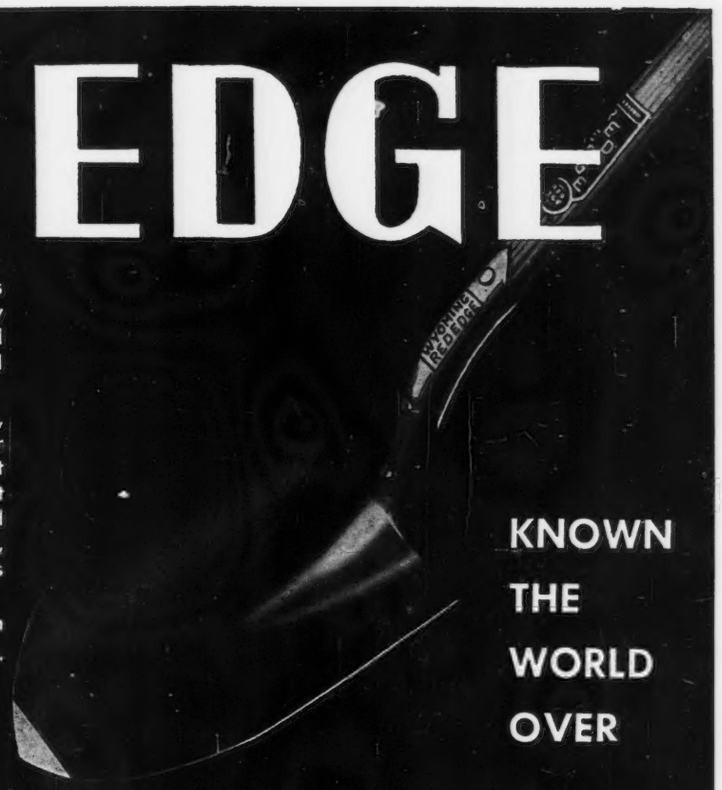

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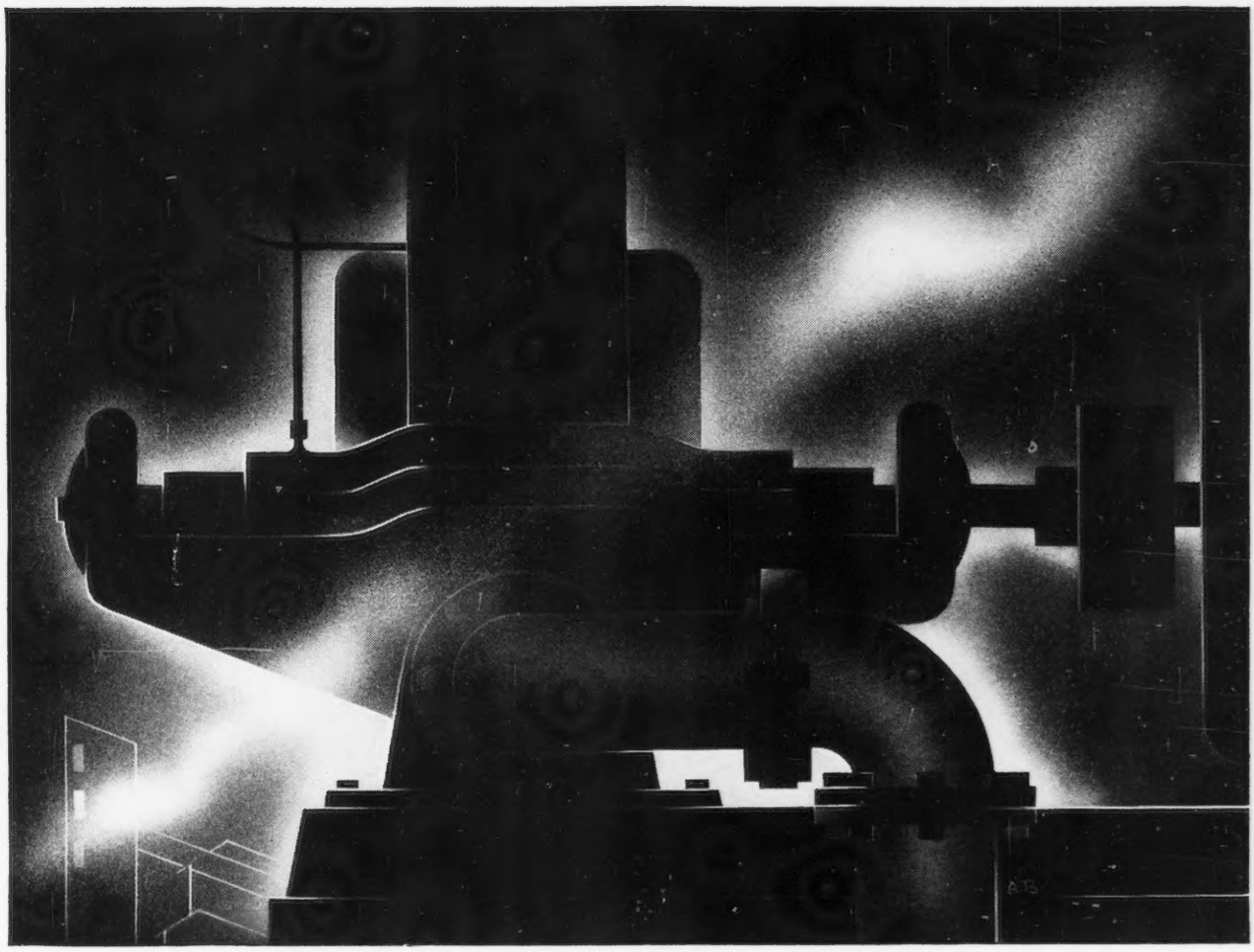

Obvious—or Effective

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MOLY

RESTLESS ROADS

Story of another Goodrich development in rubber

ALL pavement is in constant motion, expanding with heat, contracting with cold. One mile of concrete, for example, is two to three feet longer in summer than in winter. Where does that three feet go? Without some provision, the pavement would buckle and destroy itself, so concrete roads are laid in sections of 60 or 90 feet, with space between to allow for expansion, and the space filled with asphalt.

But, when the pavement expands, some of this asphalt is forced out, and you have annoying bumps. So highway departments send out crews to trim off the overflowed material. In the fall, as the pavement contracts with cold and the spaces widen, they have to be filled again, or else dirt and ice would get in between the road sections and eventually cause them to buckle. Materials which do not flow have been tried, but these would not fill the joints when the pavement contracted.

Goodrich believed there must be some better way. Goodrich discoveries in compounding had resulted in a rubber which withstands constant compression without losing its life, will flex indefinitely, will resist heat and cold, sunlight, air and water. This new rubber had been used to improve the quality of transmission and conveyor belts, hose and packing of many kinds—why couldn't it be applied to roads?

A rubber strip was finally developed and has now passed all tests by 2 years in use. It is simply pressed into the top of the space between pavement sections. When the pavement expands, the rubber strip expands downward because of its design, and you have no annoying bump in the road. When the pavement contracts, the rubber returns to its original shape—a snug fit.

Whereas the old method cost $250 a mile a year to maintain, the Goodrich expansion joint costs nothing to maintain and the original cost is about the same. Motorists will be saved from those annoying bumps, roads will last longer, and governments will save millions a year now spent in needless maintenance. The B. F. Goodrich Company, Mechanical Rubber Goods Div., Akron, Ohio.

Goodrich

ALL *products problems* IN RUBBER

EXIDE-IRONCLAD

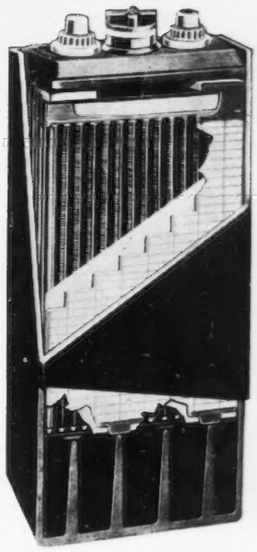
. . . . the battery that speeds up underground haulage and cuts costs

THE first thing needed in a battery for underground haulage is *power*. An abundance of power is one of the features that have made the Exide-Ironclad Battery famous wherever loads are heavy and service is tough.

To maintain production under today's conditions, haulage speeds must be maintained throughout the day, so that the last load moves as fast as the first. That's another characteristic of the Exide-Ironclad Battery, for it maintains a good voltage all day long.

For economy, the battery must be tough and rugged, able to take years of hard usage—and here the Exide-Ironclad is outstanding. Reports from users in all parts of the country indicate that these batteries are delivering far longer life than most operators anticipate — life that is trouble-free and economical from beginning to end.

Write today for free booklet, "The Storage Battery Locomotive for Underground Haulage."



Cut-away view of Exide-Ironclad cell, showing the unique positive-plate construction. Slotted rubber tubes retain the active material while exposing it freely to the electrolyte. One of the reasons for this battery's dependable performance and long life.

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With Exide **MIPOR** Separators
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All kinds of mining equipment benefit from the application of TIMKEN Bearings—and so do their operators. It will pay you to see that you have them in your new mine cars, conveyors, fans, blowers or any other equipment.

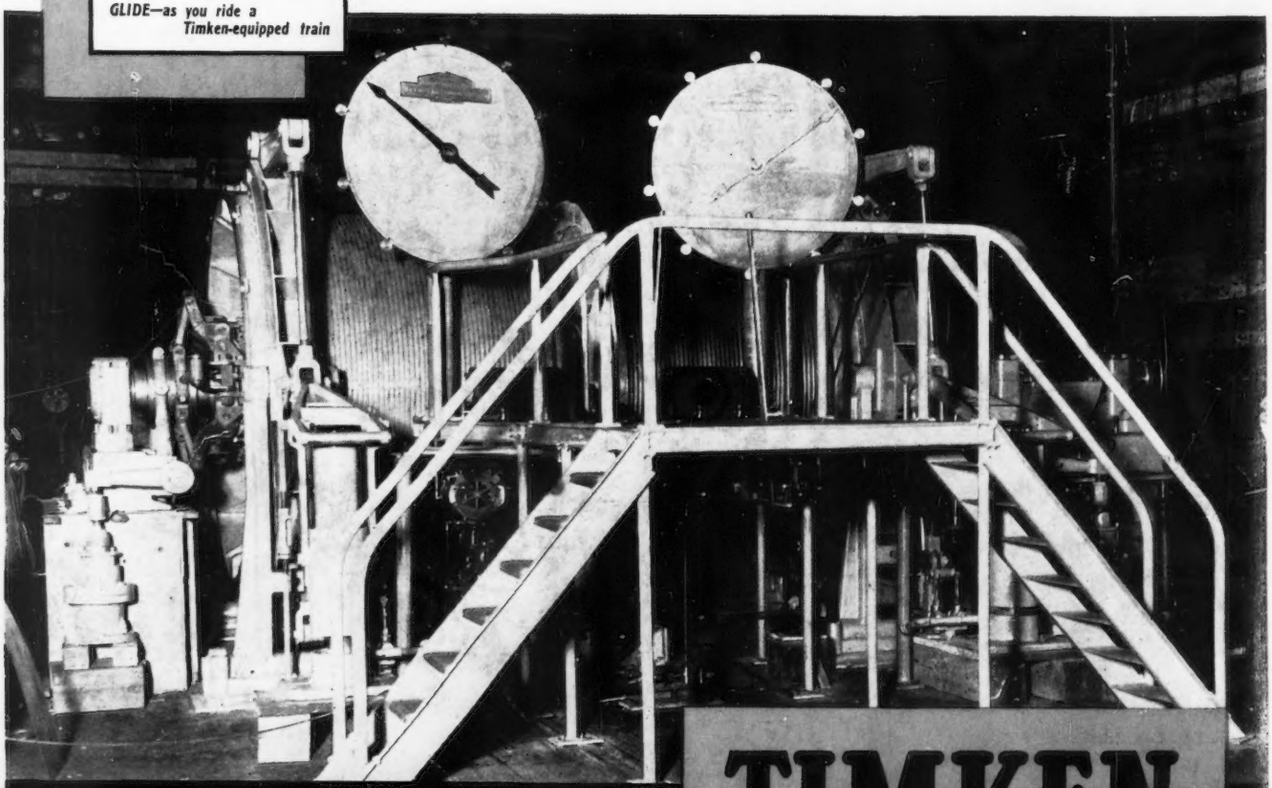
"Rebel" Streamliners of the Gulf, Mobile & Northern R. R. are Timken-equipped.

GLIDE—as you ride a Timken-equipped train

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

Tapered Roller TIMKEN BEARING EQUIPPED

Built by Coeur d'Alene Hardware & Foundry Co. Installed at the Star Mine, Burke, Idaho.



Manufacturers of Timken Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives and all kinds of industrial machinery; Timken Alloy Steels and Carbon and Alloy Seamless Tubing; Timken Rock Bits; and Timken Fuel Injection Equipment.

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